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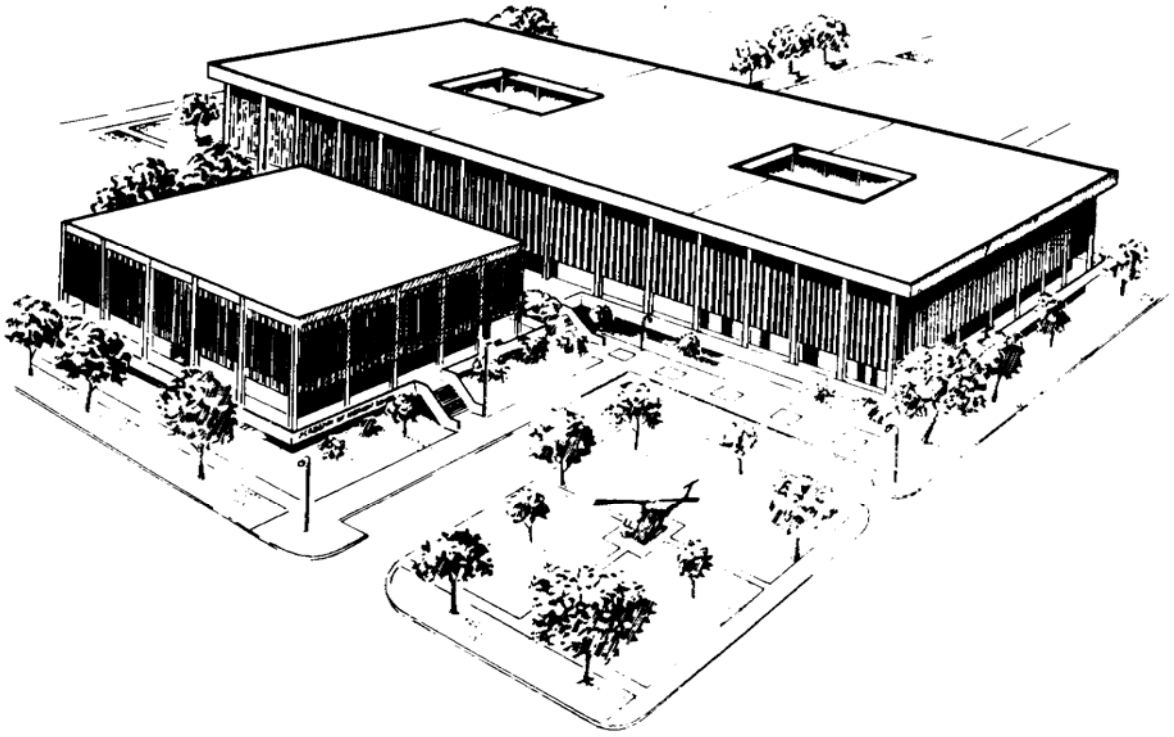
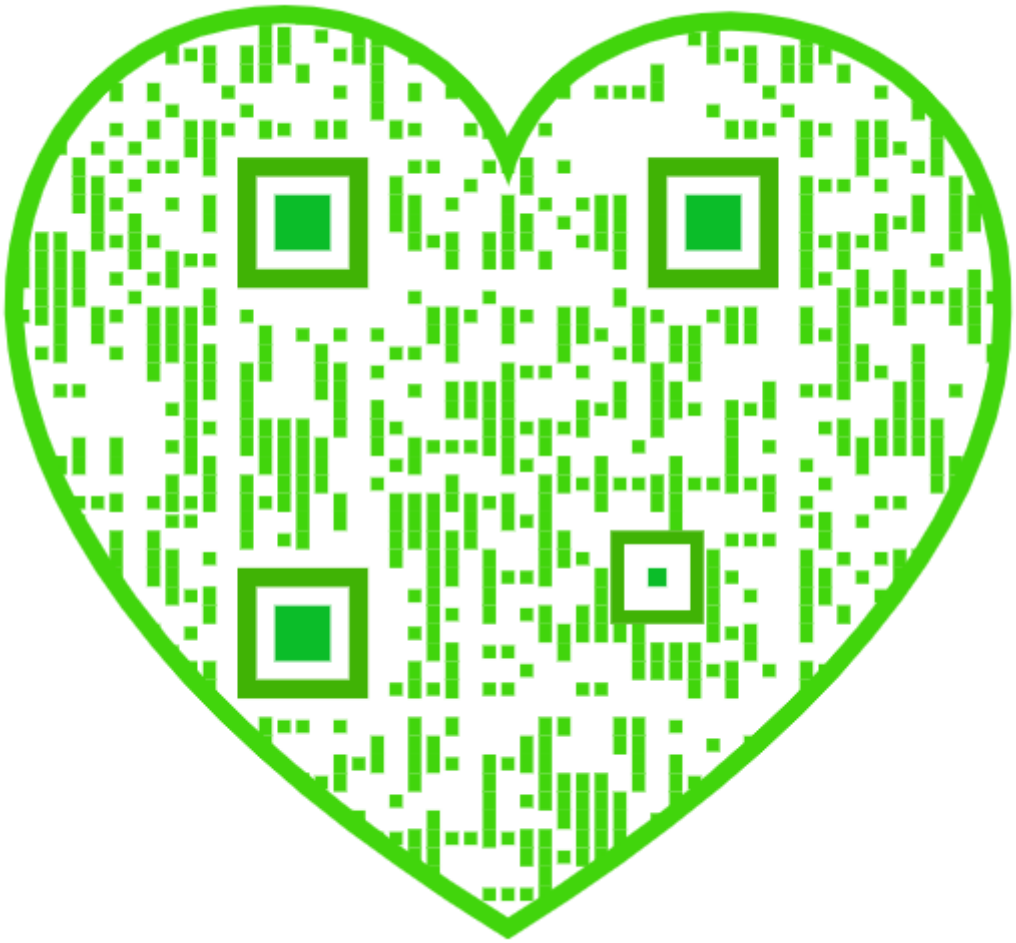


RESPIRATORY DISEASES AND DISORDERS

SUBCOURSE MD0568 EDITION 200



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When used in this publication, words such as "he," "him," "his," and "men" 'are intended to include both the masculine and feminine genders, unless specifically stated otherwise or when obvious in context.

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TABLE OF CONTENTS

Lesson **Paragraphs**

INTRODUCTION

1 ANATOMY AND PHYSIOLOGY OF THE RESPIRATORY SYSTEM

Section I. Structure and Function of the Respiratory Organs....1-1--1-5
Section II. Accessory Structures of the Respiratory System.....1-6--1-9
Section III. Physiology of Respiration 1-10--1-17
Exercises

2 PHYSICAL ASSESSMENT OF THE RESPIRATORY SYSTEM

Section I. General Approach to Physical Assessment.....2-1--2-4
Section II. Steps of the Procedure..... 2-5--2-8
Exercises

3 INFECTIOUS RESPIRATORY DISEASES

Section I. Upper Respiratory Diseases.....3-1--3-5
Section II. Upper Respiratory Diseases with Systemic Effects 3-6--3-7
Section III. Lower Respiratory Diseases.....3-8--3-10
Section IV. Other Causes of Pneumonia... 3-11--3-15
Exercises

4 CHRONIC OBSTRUCTIVE PULMONARY DISEASES

Section I. Asthma..... 4-1--4-4
Section II. Chronic Bronchitis..... 4-5--4-7
Section III. Emphysema.....4-8--4-10
Exercises

5 RESPIRATORY DISORDERS

Section I. Hyperventilation Syndrome..... 5-1--5-3
Section II. Spontaneous Pneumothorax..... 5-4--5-7
Section III. Pulmonary Embolism.....5-8--5-12
Section IV. Inhaled Toxic Substances..... 5-13--5-17
Exercises

6 TUBERCULOSIS.....6-1--6-11
Exercises

CORRESPONDENCE COURSE OF
THE U.S. ARMY MEDICAL DEPARTMENT CENTER AND SCHOOL

SUBCOURSE MD0568

RESPIRATORY DISEASES AND DISORDERS

INTRODUCTION

The respiratory tract has defense mechanisms that prevent most microorganisms and foreign objects from entering the lungs of a healthy person. Sometimes these defense mechanisms cannot resist invasion, and infection occurs. The person's defenses may be weakened, damaged, or the invading agent may be too strong for the person's body to resist. As a Medical NCO, it is extremely important that you become aware of the characteristics and treatments for respiratory problems that you may encounter. With the awareness of respiratory diseases and their general characteristics, you may be alert for signs and symptoms of such diseases in the soldiers in your care.

Subcourse Components:

The subcourse instructional material consists of six lessons as follows:

Lesson 1, Anatomy and Physiology of the Respiratory System.
Lesson 2, Physical Assessment of the Respiratory System.
Lesson 3, Infectious Respiratory Diseases.
Lesson 4. Chronic Obstructive Pulmonary Diseases.
Lesson 5. Respiratory Disorders.
Lesson 6. Tuberculosis.

Here are some suggestions that may be helpful to you in completing this subcourse:

--Read and study each lesson carefully.

--Complete the subcourse lesson by lesson. After completing each lesson, work the exercises at the end of the lesson, marking your answers in this booklet.

--After completing each set of lesson exercises, compare your answers with those on the solution sheet that follows the exercises. If you have answered an exercise incorrectly, check the reference cited after the answer on the solution sheet to determine why your response was not the correct one.

Credit Awarded:

Upon successful completion of the examination for this subcourse, you will be awarded 12 credit hours.

To receive credit hours, you must be officially enrolled and complete an examination furnished by the Nonresident Instruction Branch at Fort Sam Houston, Texas.

You can enroll by going to the web site http://atrrs.army.mil and enrolling under "Self Development" (School Code 555).

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LESSON ASSIGNMENT

LESSON 1	Anatomy and Physiology of the Respiratory System.
TEXT ASSIGNMENT	Paragraphs 1-1 through 1-17.
LESSON OBJECTIVES	After completing this lesson, you should be able to:
	1-1. Identify the structure and function of the respiratory organs.
	1-2. Identify the accessory structures of the respiratory system.
	1-3. Describe the physiology of respiration.
	1-4. Describe factors in air capacity of the lungs.
SUGGESTION	After completing the assignment, complete the exercises at the end of this lesson. These exercises will help you to achieve the lesson objectives.

LESSON 1

ANATOMY AND PHYSIOLOGY OF THE RESPIRATORY SYSTEM

Section I. STRUCTURE AND FUNCTION OF THE RESPIRATORY ORGANS

1-1. INTRODUCTION

a. **Respiration.** Respiration is the exchange of gases between the atmosphere and the cells of the body. It is a physiological process. There are two types of respiration: external respiration and internal respiration (figure 1-1). External respiration is the exchange of gases between the air in the lungs and blood. Internal respiration is the exchange of gases between the blood and the individual cells of the body.

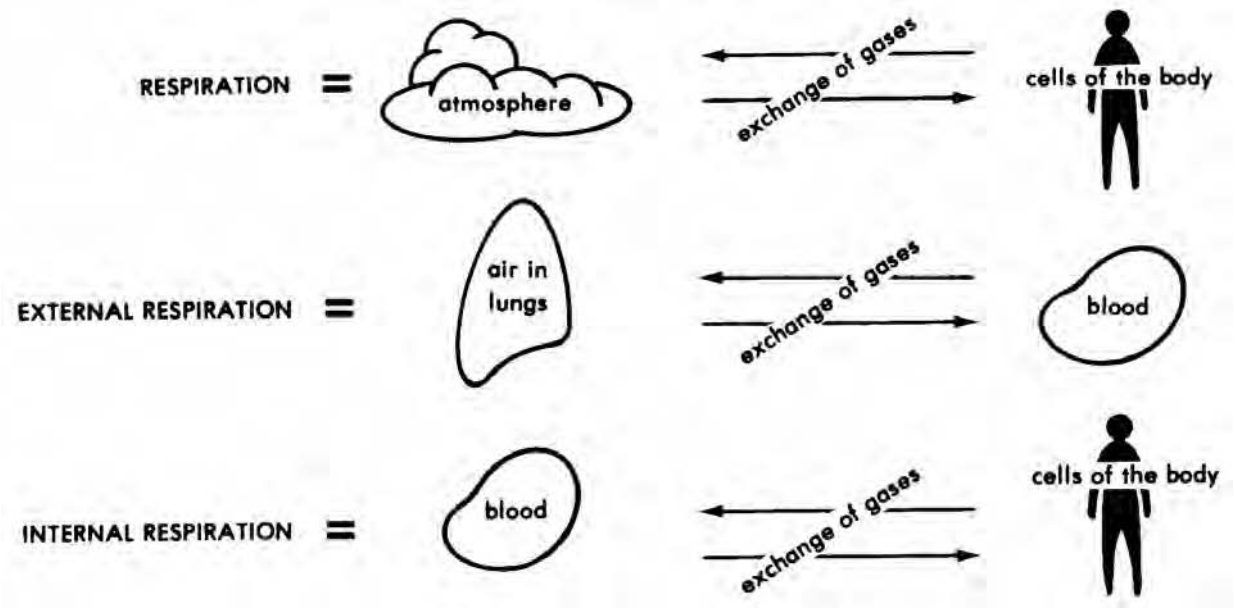

Figure 1-1. Respiration.

b. **Breathing.** Breathing is the process that moves air into and out of the lungs. It is a mechanical process. There are two types of breathing in humans: costal (thoracic) breathing and diaphragmatic (abdominal) breathing (figure 1-2). In costal breathing, the major structure causing the movement of air is the rib cage. In diaphragmatic breathing, interaction between the diaphragm and the abdominal wall causes air to move into and out of the lungs.

COSTAL BREATHING = air movement caused by rib cage

DIAPHRAGMATIC BREATHING = diaphragm<--interaction-->abdominal wall

Figure 1-2. Breathing.

1-2. COMPONENTS AND SUBDIVISIONS OF THE HUMAN RESPIRATORY SYSTEM

See figure 1-3 for an illustration of the human respiratory system.

a. **Components.** The components of the human respiratory system consist of air passageways and two lungs. Air moves from the outside of the body into tiny sacs in the lungs called alveoli (pronounced al-VE-oh-lie).

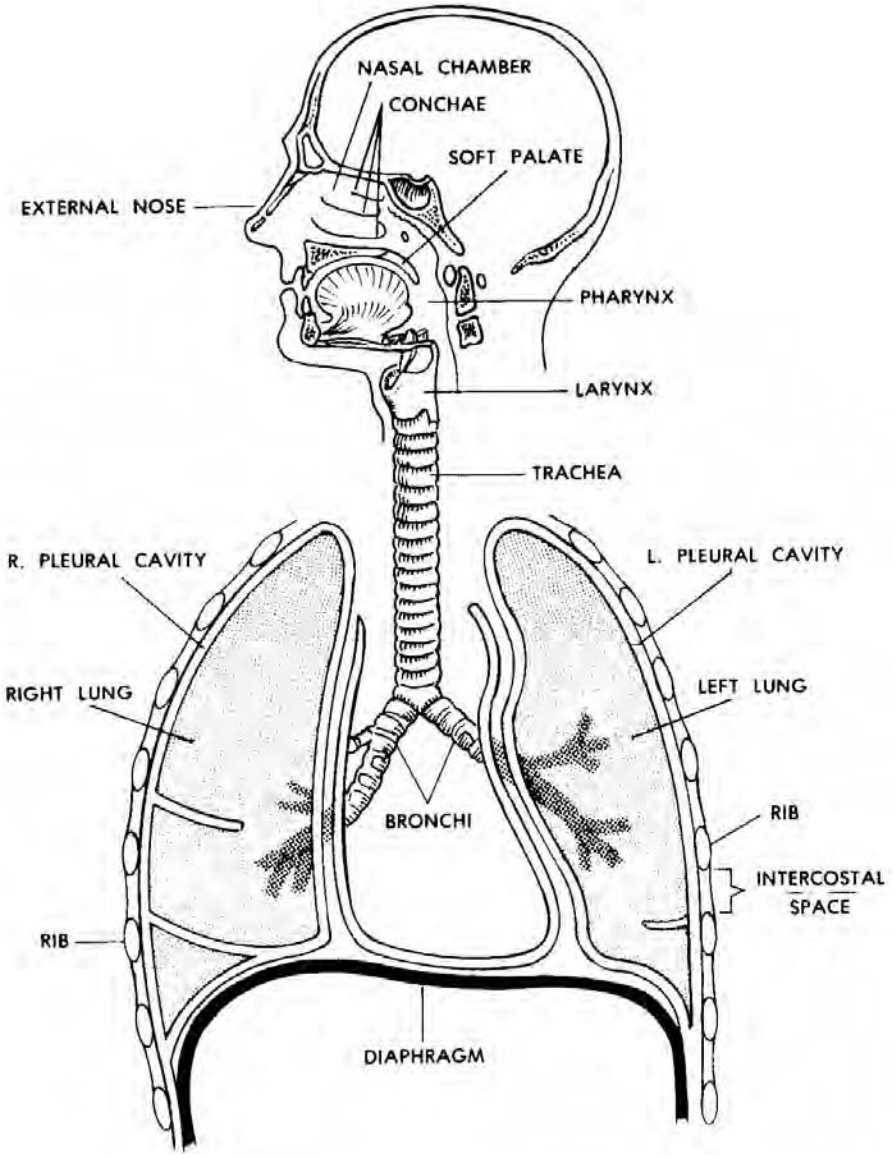

Figure 1-3. The human respiratory system.

b. **Main Subdivisions.** The main subdivisions of the respiratory system may be identified by their relationship to the voice box or larynx. Thus, the main subdivisions are as follows:

SUBDIVISION	FUNCTION
SUPRALARYNGEAL STRUCTURES (su-prah-lah-RIN-je-al)	Cleanse, warm, moisten, and test inflowing air.
LARYNX (voice-box) (LARE-inks)	Controls the volume of inflowing air; produces selected pitch (vibration frequency) in the moving column of air.
INFRALARYNGEAL STRUCTURES (in-frah-lah-RIN-je-al)	Distributes air to the alveoli of the lungs where actual respiration takes place.

1-3. SUPRALARYNGEAL STRUCTURES

See figure 1-4.

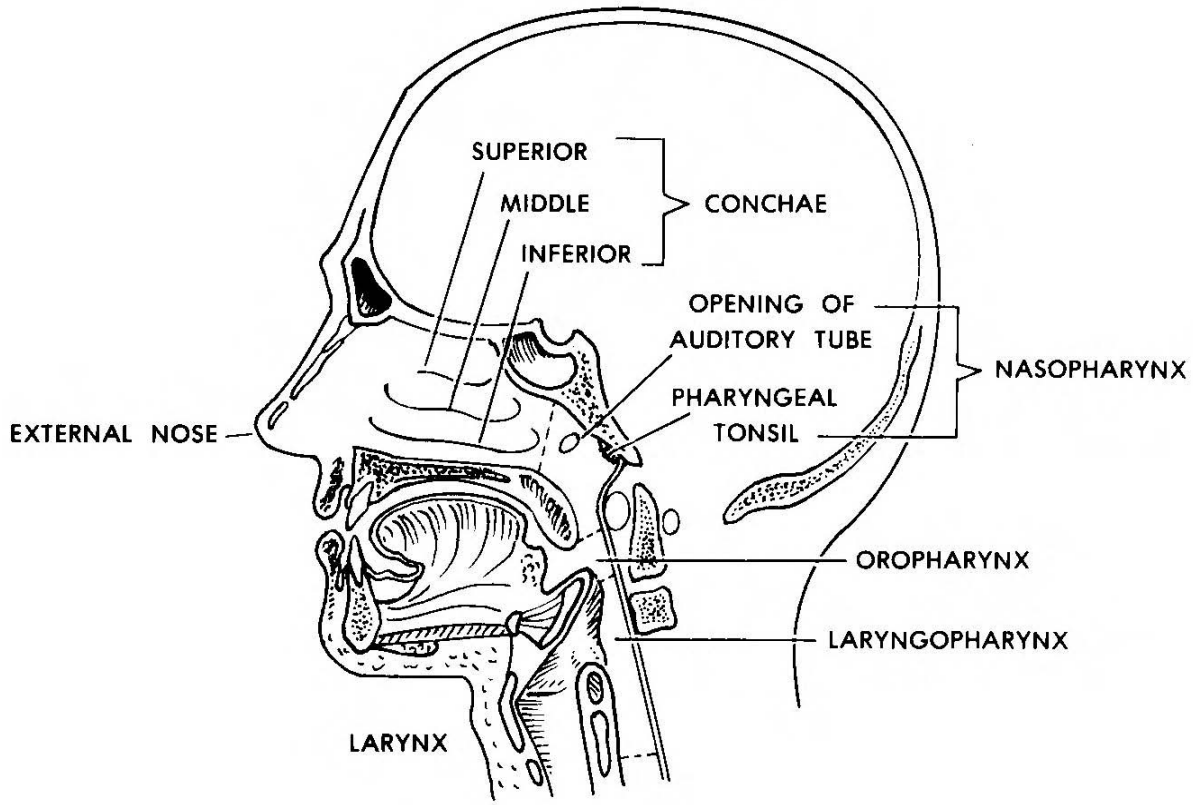

Figure 1-4. Supralaryngeal structures.

a. **Nose.** There is an external nose, the part projecting from the face, and an internal nose, the portion that is inside the skull.

(1) External portion of the nose. A supporting framework of bone and cartilage covered with skin and lined with mucous membrane makes up the external nose. Nasal bones form the bridge of the nose and hold it in a fixed position. The rest of the external nose is flexible because it has a framework of pliable cartilage. The midline divider of the external nose is called the nasal septum. Two openings called the nostrils or external nares are on the underside of the external nose. These nostrils lead to paired spaces (vestibules).

(2) Internal portion of the nose. Behind each vestibule of the external nose is a nasal chamber. The two chambers together form the internal nose. These chambers are separated by the nasal septum.

(a) Mucoperiosteum. The walls of the nasal chambers are lined with a thick mucous-type membrane known as the mucoperiosteum. This lining is moist and full of blood vessels. As air is inhaled and passes over this lining, several changes happen to the inhaled air. Blood in the lining's blood vessels warms the air. The air picks up moisture from the lining. Dust sticks to the mucous of the lining resulting in relatively dust-free air.

(b) Conchae. The lateral wall of each nasal chamber has three scroll-like extensions into the chamber, which help increase the surface area exposed to inflowing air. These scroll-like extensions are known as conchae.

CONCHA = sea shell (pronounced KON-kah)

CONCHA (singular), Conchae (plural)

(c) Olfactory epithelium (membrane). The olfactory epithelium is a membrane that lines the upper nasal chambers. The olfactory receptors (nerve endings responsible for the sense of smell) are located in this membrane.

(d) Paranasal sinuses. Paranasal sinuses (figure 1-5) are air "cells" or cavities in the skull. They are connected with the nasal chambers and are lined with the same ciliated mucoperiosteum. These sinuses are extensions of the nasal chambers into the skull bones. For this reason, they are known as paranasal sinuses.

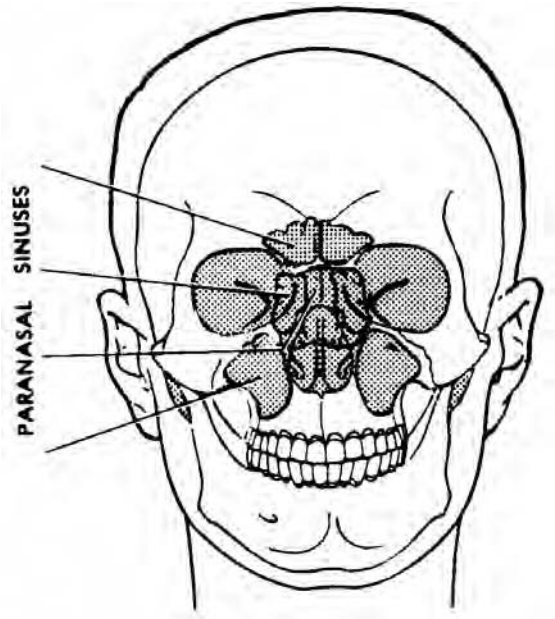

Figure 1-5. The nose.

b. **Pharynx.** The pharynx (FAIR-inks) is the common posterior space for the respiratory and digestive systems. It is about 13 cm or 5 inches long and is shaped a little like a funnel. It starts at the internal nares and extends partway down the neck. The wall of the pharynx is made up of skeletal muscles and lined with a mucous membrane.

(1) Function. The pharynx has two functions: it serves as a passageway for air and food, and it provides a resonating chamber (amplifying sounds) for speech sounds.

(2) Divisions. The pharynx can be divided into three parts: the nasopharynx, the oropharynx, and the laryngopharynx.

(a) Nasopharynx. The part of the pharynx specifically related to the respiratory system is the nasopharynx. It is located above the soft palate. The two posterior openings (nares or nostrils) of the nasal chambers lead into the single space of the nasopharynx. The auditory tubes (also called the eustachian tubes) open into the nasopharynx. The auditory tubes connect the nasopharynx with the middle ears to equalize the pressure between the outside and inside of the eardrum. The pharyngeal tonsils (adenoids) are located in the upper posterior wall of the nasopharynx. The soft palate, floor of the nasopharynx, is a trapdoor which closes off the upper respiratory passageways during swallowing.

(b) Oropharynx. This is the part of the pharynx which is closely related to the digestive system. It is located below the soft palate and above the upper edge of the epiglottis. (The epiglottis is the flap that prevents food from entering the larynx during swallowing.)

(c) Laryngopharynx. The part of the pharynx which is common to the respiratory and digestive systems is the laryngopharynx. It is the part of the pharynx below the edge of the epiglottis. The digestive and respiratory systems lead into this part from above and lead off from it below.

1-4. LARYNX

The larynx (figure 1-6), also called the voice box, connects the pharynx with the trachea. The larynx is located in the anterior region of the neck and has a box-like shape (see figure 1-3). The voice box of the male becomes larger and heavier during puberty causing the male's voice to get deeper. An adult male's voice box tends to be located lower in the neck than the female's voice box. The female's larynx remains higher and smaller causing the female's voice to be a higher pitch.

a. **Structure.** Nine pieces of cartilage support the larynx: three single pieces of cartilage and three paired pieces of cartilage. The three single pieces are the thyroid cartilage, epiglottic cartilage (epiglottis), and cricoid cartilage. The three paired pieces of cartilage are arytenoid cartilages, corniculate cartilages, and cuneiform cartilages.

(1) Thyroid cartilage. Sometimes called the Adam's apple, this cartilage is made up of two fused plates which form the anterior wall of the larynx. These plates cause the larynx to be triangular in shape. The thyroid cartilage is larger in males than in females.

(2) Epiglottic cartilage (epiglottis). This cartilage lies on top of the larynx and is shaped like a large leaf. The "stem" of the epiglottis is attached to the thyroid cartilage. The "leaf" of the epiglottis is unattached and moves up and down freely. During swallowing, the larynx moves up causing the free edge of the epiglottis to form a lid over the glottis, and the glottis is closed. The glottis is the hole between the vocal cords in the larynx. Air passes through the glottis into the main chamber of the larynx (below the cords) and then into the trachea. The covering over the glottis allows the larynx to be closed off. Liquids and foods then move into the esophagus and are kept out of the trachea. A cough reflex takes place in an effort to expel anything other than air that gets into the larynx.

(3) Cricoid (KRI-koyd) cartilage. This is a ring of cartilage that forms the interior wall of the larynx. It is attached to the first ring of the trachea.

(4) Arytenoid (ar-i-TE-noyd) cartilages (paired). The arytenoid cartilages are located at the superior border of the cricoid cartilage and are shaped like pyramids. These cartilages are attached to the vocal folds and pharyngeal muscles. The action of these cartilages causes the vocal cords to move.

(5) Corniculate (kor-NIK-yoo-lat) cartilages (paired). These cartilages are located at the apex of each arytenoid cartilage. They are shaped like a cone.

(6) Cuneiform (kyoo-NE-i-form) cartilages (paired). Cuneiform cartilages are shaped like rods. These cartilages connect the epiglottis to the arytenoid cartilages.

b. **Voice Cords.** The mucous membrane of the larynx contains two pairs of folds: the superior folds (false vocal cords) and the inferior folds (true vocal cords).

(1) Superior folds (false vocal cords). If these folds are brought together, they function in holding the breath against pressure in the thoracic cavity. Humans hold their breath when they push against something heavy or pick up a heavy object.

(2) Inferior folds (true vocal cords). The movement of air across these vocal cords produces sounds. Tension on the vocal cords controls pitch. Men usually have thicker and longer vocal folds. This causes the vocal folds to vibrate more slowly giving males a lower range of pitch than females.

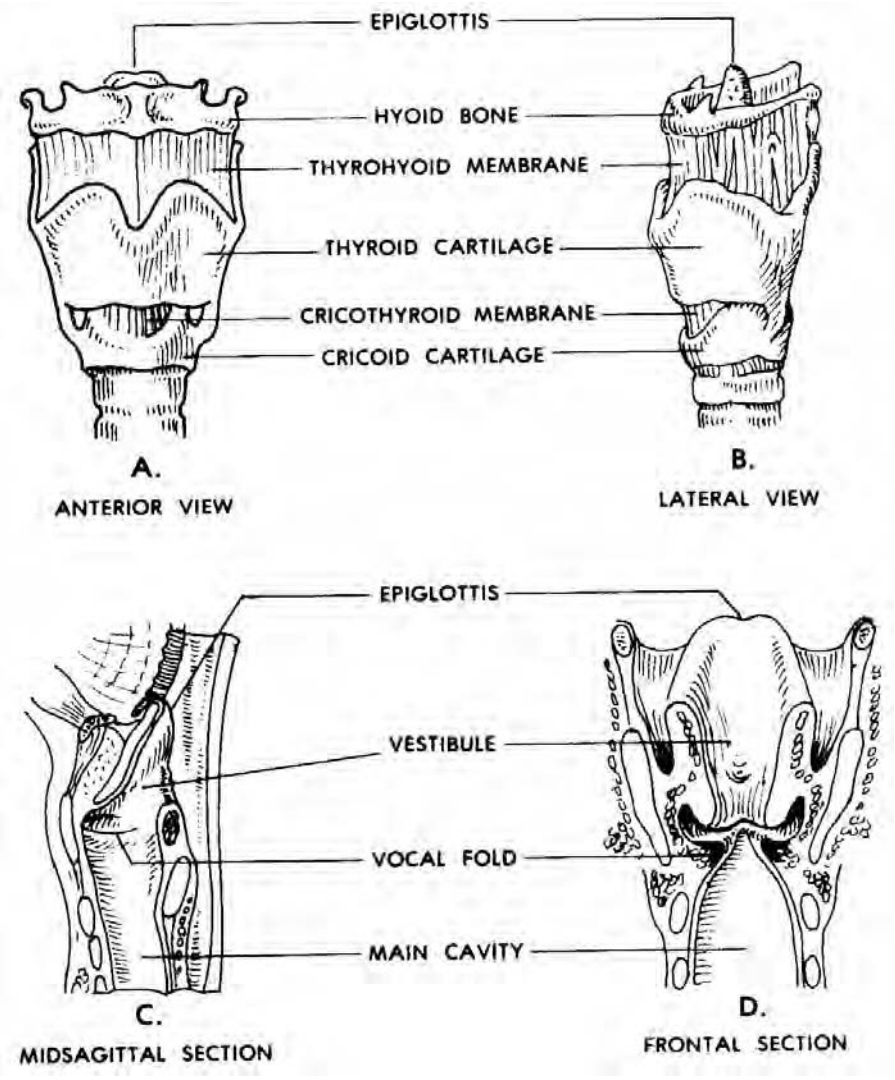

Figure 1-6. The larynx.

1-5. INFRALARYNGEAL STRUCTURES

a. **Trachea and Bronchi.** The respiratory tree (figure 1-7) is the set of tubular structures that carry air from the larynx to the alveoli of the lungs. If you were to turn figure 1-7 UPSIDE DOWN, the trachea would become the trunk of the tree, and the bronchi would be the branches. (NOTE: Figure 1-7 is right side up.) These tubular parts are held open by rings of cartilage. The lining is ciliated to remove mucus and other materials that get into the passageway.

b. **Alveoli.** The alveoli (alveolus, singular) are tiny round (balloon-like) sacs that are connected to larger tubes of the lungs by tiny tubes known as alveolar ducts and bronchioles. The alveoli are so small that there are billions in adult lungs. This very small size produces a maximum surface area through which external respiration takes place. External respiration is the actual exchange of gases between the air in the alveolar spaces and the adjacent blood capillaries through their walls. The inner surfaces of the alveoli must be kept wet in order for this transfer of gases to be possible.

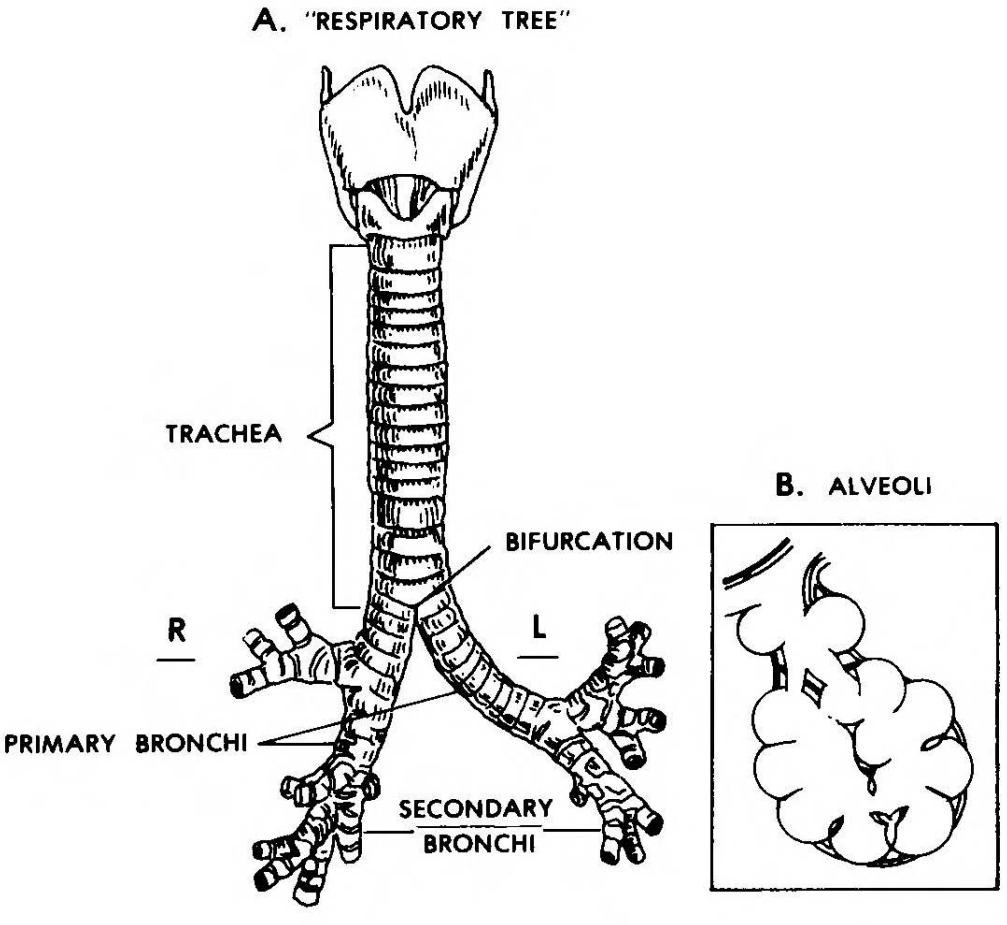

Figure 1-7. Infralaryngeal structures ("respiratory tree").

c. **Lungs.** A lung is an individual organ composed of tubular structures and alveoli bound together by porous, spongy, elastic type, fibrous connective tissue. In humans, there are two lungs: the right lung and the left lung. Each lung is supplied by a primary or mainstem bronchus leading off the trachea.

(1) Structure. The right lung is larger in volume and shorter than the left lung. The left lung must leave room for the heart. The right lung is divided into three pulmonary lobes (upper, middle and lower) and 10 bronchopulmonary segments (2 + 3 + 5). The left lung is smaller and narrower than the right lung and is divided into two pulmonary lobes (upper and lower) and eight bronchopulmonary segments (4 + 4). A pulmonary lobe is a major subdivision of a lung marked by fissures (deep folds). Each lobe is further partitioned into bronchopulmonary segments. Each lobe is supplied by a secondary or lobar bronchus. Each segment is supplied by a tertiary or segmental bronchus, a branch of the lobar bronchus.

(2) Lung lobules. Each bronchopulmonary segment of the lung is divided into many small compartments called lobules. See figure 1-8. Elastic connective tissue is wrapped around each lobule. Each lobule has a lymphatic vessel, an arteriole, a venule, and a branch from a terminal bronchioles. Terminal bronchioles further subdivide into tiny branches called respiratory bronchioles. Respiratory bronchioles subdivide into several (2 to 11) alveolar ducts. Many alveoli and alveolar sacs surround the alveolar duct.

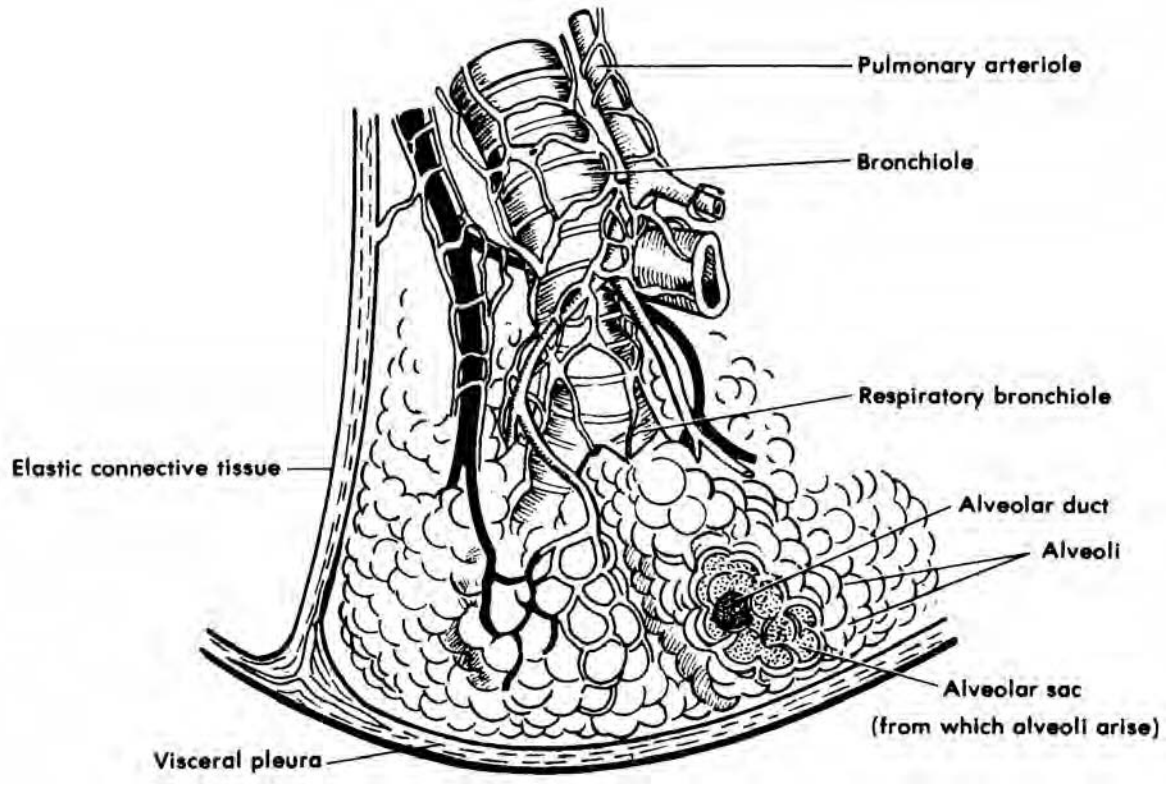

Figure 1-8. Diagram of a lung lobule.

Section II. ACCESSORY STRUCTURES OF THE RESPIRATORY SYSTEM

NOTE: All of the structures in this section play a part in the functioning of the respiratory system.

1-6. DIAPHRAGM

The diaphragm, the chief muscle of respiration, is a thin, but strong, dome-shaped muscular membrane. It separates the abdominal and thoracic cavities. The diaphragm is attached to the inferior margin of the rib cage and to the bodies of the lumbar vertebrae behind. As a muscular membrane, it domes upward into the thoracic cavity. Upon contraction, the fibers of the diaphragm shorten and pull downward. This downward motion produces a piston-like pressure on the contents of the abdominopelvic cavity.

1-7. INTERCOSTAL MUSCLES

a. The intercostal spaces are filled by two layers of intercostal muscles. The intercostal muscles extend from the vertebrae behind to the sternum in front. A strengthening "plywood effect" is created by the arrangement of the two layers at a right angle to each other. These muscles help maintain the "solid-wall" condition of the thorax. For this reason, a pressure gradient can be maintained between the inside and outside of the thorax.

b. The intercostal muscles play a part in the mechanics of breathing. Quiet breathing takes place due to the alternate contraction and relaxation of the diaphragm and the internal intercostal muscles. As an individual breathes in, the diaphragm contracts and, at the same time, the external intercostal muscles contract causing the ribs to be pulled upward and the sternum to be pushed forward. This increases the anterior-posterior diameter of the thoracic cavity. (The volume of the chest cavity increases.) When the individual breathes out, the external intercostal muscles relax, the ribs move downward, and, as the diaphragm relaxes, the thoracic cage moves upward. These movements decrease the vertical and anterior-posterior diameters of the thoracic cavity. The thoracic cavity (smaller in volume) returns to its resting size.

1-8. THORAX

The thorax is the chest. The thorax is the portion of the trunk consisting of the sternum, the costal cartilages, the ribs, and the bodies of the thoracic vertebrae. Located above the diaphragm, the thoracic cage is roughly cone-shaped, the narrow portion being superior and the broad portion inferior. It is flattened from front to back. The thoracic cage is open to the outside by way of the neck and head. This bony cage encloses and protects the lungs and other structures of the chest cavity. The thorax also provides support for the bones of the shoulder girdle and upper extremities. Since the wall of the thorax is reinforced by special muscles, bones, and cartilages, we can consider the thorax to be a "solid-walled container."

1-9. PLEURA

Surrounding each lung individually is a serous cavity called the pleural cavity (figure 1-9). The minute quantity of serous fluid in the cavity serves as a lubricant. This serves to minimize friction for the expansion and contraction of the lungs during breathing.

a. Each lung is covered with a serous membrane called the visceral pleura. The outer wall of the pleural cavity is lined with another serous membrane known as the parietal pleura. Areas of the parietal pleura are variously named according to their location. The mediastinal pleura form the lateral wall of the mediastinum. The diaphragmatic pleura cover the superior surface of the diaphragm. The costal pleura line the inner surface of the rib cage. The cupolar pleura form a dome-like extension into the root of the neck. It contains the apex of the lung.

b. When each lung is in its smaller volume, its corresponding diaphragmatic pleura lies close to the lower costal pleura. The slit-like cavity between them is called the costophrenic sinus. Fluids of each pleural cavity tend to collect in this sinus since it is the lowest area for each. When the diaphragm contracts and flattens out, each costophrenic sinus opens up, and the inferior portion of the expanding lung occupies this space.

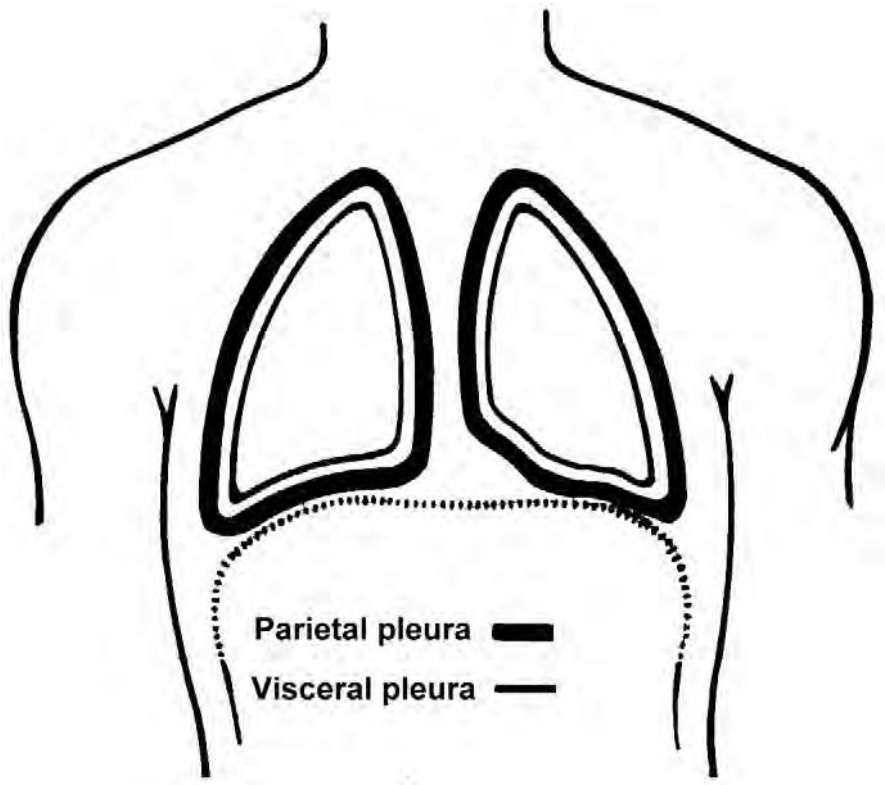

Figure 1-9. Lungs, visceral, and parietal pleura.

Section III. PHYSIOLOGY OF RESPIRATION

1-10. INTRODUCTION

a. Boyle's law tells us that as the volume (V) of a gas-filled container increases, the pressure (P) inside decreases; as the volume (V) of a closed container decreases, the pressure (P) inside increases. When the connected spaces of air have different pressures, the air moves from the space with greater pressure to the one with lesser pressure.

b. In regard to breathing, we can consider the air pressure around the human body to be constant. The pressure inside the lungs may be greater or less than the pressure outside the body. Thus, a greater internal pressure causes air to flow out; a greater external pressure causes air to flow in.

c. We can compare the human trunk to a hollow cylinder. This cylinder is divided into upper and lower cavities by the diaphragm. The upper is the thoracic cavity and is essentially gas-filled. The lower is the abdominopelvic cavity and is essentially water-filled.

1-11. COSTAL (THORACIC) BREATHING

a. **Inhalation.** Muscles attached to the thoracic cage raise the rib cage. A typical rib might be compared to a bucket handle, attached at one end to the sternum (breastbone) and at the other end to the vertebral column. The "bucket handle" is lifted by the overall movement upward and outward of the rib cage. These movements increase the thoracic diameters from right to left and from front to back. Thus, the intrathoracic volume increases. Recalling Boyle's law, the increase in volume leads to a decrease in pressure. The air pressure outside the body then forces air into the lungs and inflates them.

b. **Exhalation.** The rib cage movements and pressure relationships are reversed for exhalation. Thus, intrathoracic volume decreases. The intrathoracic pressure increases and forces air outside the body.

1-12. DIAPHRAGMATIC (ABDOMINAL) BREATHING

a. **Inhalation.** As the diaphragm contracts, the dome flattens, and the diaphragm descends. This increases the depth (vertical diameter) of the thoracic cavity thus increasing the cavity's volume. At the same time, air pressure in the thoracic cavity decreases. Now, air pressure outside the body is greater, a condition which forces air into the lungs.

b. **Exhalation.** As the diaphragm relaxes, the elastic abdominal wall forces the diaphragm back up by pushing the watery tissues of the abdomen against the underside of the relaxed diaphragm. The dome extends upward. Air is forced out of the lungs.

1-13. CARBON DIOXIDE TRANSPORT AND ELIMINATION

a. **The Reason for Breathing.** Humans breathe to supply oxygen to the cells of the body and to remove the waste product, carbon dioxide (CO_2). About one-fifth of the air around us is oxygen. In the process of breathing, or respiration, the body brings air into the lungs. In the lungs, some of the oxygen moves into the bloodstream. A waste gas, carbon dioxide, moves from the blood into the air in the lungs where it is breathed out. The name of this process is the exchange of gases.

b. **The Exchange of Gases.** The actual exchange of oxygen and carbon dioxide takes place in tiny air sacs, the alveoli. The alveoli are in direct contact with capillaries that carry blood. The alveoli walls and the capillary walls are moist and very thin--much thinner than tissue paper. Oxygen molecules seep from the alveoli through the membranes (thin walls) into the blood of the capillaries. Hemoglobin picks up oxygen in the red blood cells. At the same time, blood plasma gives up carbon dioxide to the air in the alveoli. Figure 1-10 illustrates this exchange.

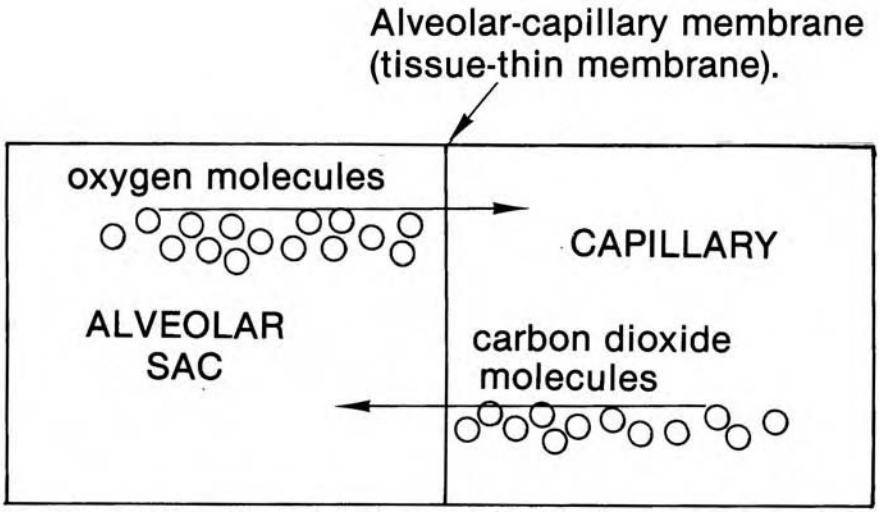

Figure 1-10. Exchange of gases.

1-14. REGULATION OF RESPIRATION

The basic rhythm is set and coordinated by the respiratory center; however, the rhythm can be modified in response to the demands of the body by the nerve (neural) center.

RESPIRATORY CENTER = neurons (any of the conducting cells of the nervous system) in the reticular formation of the brain stem that regulate the rate of respiration.

VENTILATION = the volume of air exchanged in one minute.

a. **Brain Influences (Cortical Influences)**. The brain can send a message to the respiratory center allowing humans to voluntarily control breathing and even stop breathing for a short time. The fact that we can voluntarily stop breathing is a protection because in this way we can keep water or irritating gases from entering our lungs. However, when CO_2 builds up to a certain level in our blood, impulses are sent to the inspiratory muscles, causing us to breathe whether we want to or not. It is not possible to kill yourself by holding your breath.

b. **Medullary Rhythmicity Area.** This area controls the basic rhythm of respiration. The respiratory center in the medulla (an inner layer of an organ) adjusts the alveolar ventilation almost exactly to the demands of the body. The result is that there is hardly any change of oxygen and carbon dioxide in arterial blood. The respiratory center of the medulla or its immediate vicinity is the primary site of action of carbon dioxide and hydrogen ions. Reduced oxygen concentrations in the blood stimulate chemoreceptors (a receptor sensitive to chemical changes in the blood stream). Impulses are transmitted to the respiratory center to increase ventilation (the volume of air exchanged in one minute) when these receptors are stimulated. Normally, the increase in ventilation prevents a rise in carbon dioxide to the point that the respiratory center would be stimulated.

1-15. FACTORS THAT CAN DECREASE OXYGEN TRANSPORT TO TISSUES

a. **Decreased Levels of Hb.** Hb is reduced hemoglobin (hemoglobin that has not combined with oxygen). Since oxygen does not dissolve well in water, very little oxygen can be carried by water through the body. Hb (hemoglobin) combines with oxygen and carries about 97 percent of the needed oxygen to various parts of the body. If there is less Hb in the body to combine with and carry oxygen around, there will necessarily be less oxygen transported to tissues of the body.

b. **Cardiac Failure.** The cardiovascular system transports gases in the blood between the lungs and the cells. The heart pumps blood carrying oxygen through the body. The cells of the body cannot survive long if they are starved for blood carrying oxygen. If oxygen is withheld from the cells of the brain for 5 to 6 minutes, a person can suffer severe and permanent brain injury or death.

c. **Decreased Rate of Respiration.** In order for a human to survive, there must be a continuous supply of oxygen to the blood as well as a continuous removal of carbon dioxide from the body. Respiration, the inhaling of oxygen and expelling of carbon dioxide, takes care of the oxygen and carbon dioxide levels in the body. If the respiration rate is lowered, an individual may have enough oxygen but too much carbon dioxide in the body.

d. **Disease Processes of Lungs or Component Parts.**

(1) Lung cancer. People inhale many irritating substances as a part of ordinary breathing. Inhaled smoke and almost all pollutants have an irritating effect on the bronchial tubes and lungs. These pollutants act as stresses or irritating stimuli. A common lung cancer, bronchogenic carcinoma, starts in the walls of the bronchi and is caused by stress and irritation.

(2) Nasal polyps. These polyps, protruding growths of mucous membrane hanging down from the posterior wall of the nasal septum, are bluish-white tumors. As they become larger, they may fill the nasopharynx making breathing through the nose difficult. A doctor can remove these polyps easily.

(3) Bronchial asthma. Usually, bronchial asthma is caused by an allergy to edible or air-borne substances--for example, wheat or dust. Muscles in the walls of the small bronchi and bronchioles go into spasms caused by the allergy. Also, the smaller bronchi and bronchioles may be clogged with excessive amounts of mucous making breathing difficult.

(4) Bronchitis. Bronchitis is inflammation of the bronchi. The most important cause of chronic bronchitis is cigarette smoking. (Chronic bronchitis is bronchitis that lasts for at least three months of the year for two successive years.)

(5) Emphysema. In this disease, the alveolar walls lose their elasticity and remain filled with air during expiration. The word "emphysema" means "blown up" or "full of air." A person with emphysema must actively work to exhale. Also, as a result of damage to the alveolar-capillary membrane, the respiration rate slows down. Removing the irritating stimuli-- air pollution, occupational exposure to dust, cigarette smoking--can slow down the progressive deterioration.

(6) Pneumonia. Pneumonia is an acute infection or inflammation of the alveoli. The amount of air space in the lungs is reduced because the alveolar sacs fill up with fluid and dead white cells. A bacteria called pneumococcus bacterium is the most common cause of this disease, but other bacteria or a fungus may also cause pneumonia. Several viruses may cause viral pneumonia.

(7) Tuberculosis. Tuberculosis is caused by bacteria-- Mycobacterium tuberculosis--which destroys parts of the lung tissue. Tuberculosis bacteria are spread by inhaling, can live through some disinfectants, but are killed by sunlight. This disease is sometimes associated with crowded, poorly lit housing. A person with tuberculosis must have rest, sunlight, and good diet.

(8) Coryza (common cold) and Influenza (flu). Common colds are caused by viruses and typical symptoms include sneezing, excessive nasal secretion, and congestion. (A fever is not usually one of the symptoms.) A virus also causes influenza (flu) with accompanying symptoms of chills, fever (usually higher than 101ºF), headache, and muscular aches. As the fever subsides, cold-like symptoms appear.

1-16. RESPIRATORY CYCLE

a. A respiratory cycle (figure 1-11) consists of one inspiration, one rest period, and one expiration--in that order.

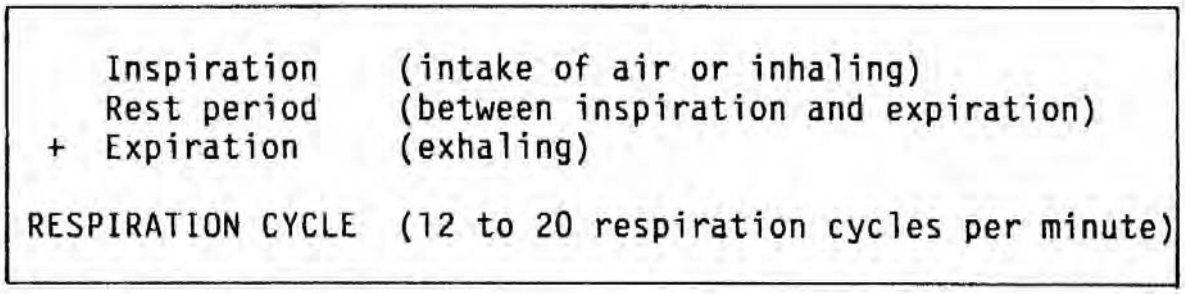
Inspiration (intake of air or inhaling)
Rest period (between inspiration and expiration)
+ Expiration (exhaling)
RESPIRATION CYCLE (12 to 20 respiration cycles per minute)

Figure 1-11. Respiratory cycle.

b. Air is made up of several gases, the most important being oxygen. Carbon dioxide and nitrogen are also present along with some other gases in small amounts. The air we breathe in is not the same as the air we breathe out. Look at the gases in the air in figure 1-12 below.

Air breathed in (inhaled)		Air breathed out (exhaled)
Nitrogen	79.02%	79.2%
Oxygen	20.94%	16.3%
Carbon Dioxide	0.04%	4.5%

Figure 1-12. Gases in the air.

c. You can see that air breathed out has less oxygen than air breathed in. The body has used some of the oxygen. Air breathed out has more carbon dioxide than air breathed in. The body is expelling carbon dioxide that has been formed as body cells work and use up oxygen.

1-17. AIR CAPACITY OF THE LUNGS

The amount of air in the lung of a man of average size who is resting is about 3 liters. When the man breathes in (inspiration or inhalation), he pulls in about 500 milliliters of air. When he deliberately breathes in (forced maximum inspiration), the amount of air in the lung rises to about 6 liters. When the same man forces the maximum amount of air out of the lung, the volume of air is down to about 1 liter. Here are important facts about volume of air and the lungs:

NOTE: 1 milliliter (ml) = 1 cubic centimeter (cc).

a. The total capacity of the lungs is about 6,000cc (maximum).

b. Tidal air volume is the amount of air inhaled or exhaled with each breath, whether the body is at rest or engaged in an activity. For the average adult male who is resting, the tidal volume is about 500cc of air.

c. Reserve air is air in the lungs that can be exhaled after normal exhalation. The amount of this air is about 1,500cc.

d. Residual air is air that is in the lungs after normal, forceful expiration (about 1,200cc).

e. Vital capacity (usually 4,800cc) is the volume of air that can be expelled after full inspiration.

Continue with Exercises

EXERCISES, LESSON 1

INSTRUCTIONS: Answer these exercises by writing the answer in the space provided. After you have answered all the exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers.

1. The exchange of gases between the atmosphere and the cells of the body is _____.

2. The exchange of gases between the air in the lungs and the blood is _____..

3. The exchange of gases between the blood and individual cells of the body is _____.

4. The process that moves air into and out of the lungs is a mechanical process called _____.

5. In _____ breathing, air movement is caused by the rib cage; in _____ breathing, movement between the abdominal wall and the diaphragm cause air movement in and out of the lungs.

6. The main subdivisions of the respiratory system are the supralaryngeal structures, the _____ and the _____ structures.

7. The paranasal sinuses are _____.

8. The olfactory epithelium, a membrane lining the _____, houses the nerve endings responsible for the _____.

9. The _____ is the portion of the nose inside the skull.

10. The three parts of the pharynx are the _____, _____, and the _____.

11. The _____ cartilage is a ring of cartilage forming the interior wall of the larynx.

12. The _____ cartilage is larger in males than females and causes the larynx to be triangular shaped.

13. The trachea and the bronchi are tubular structures which carry air from the larynx to _____.

14. A lung is an individual organ composed of _____ structures and _____ bound together by porous, spongy, elastic-type, fibrous connective tissue.

15. _____is a membrane enfolding lungs and lining the walls of the chest cavity.

16. Humans can voluntarily control breathing and even stop breathing for a short time because the brain sends a message to the _____.

17. Three factors which could decrease oxygen transportation to body tissues are decreased levels of Hb, c_____ f_____ and d_____ r_____ of r_____.

18. Air breathed out has more carbon dioxide than air breathed in because _____.

19. The total capacity of the lungs is about _____ cc.

20. Vital capacity of the lungs (usually about 4,800 cc) is _____ _____

21. The inner surfaces of the alveoli must be kept wet to _____ _____.

22. The chief muscle of respiration is the _____.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES, LESSON 1

1. Respiration. (para 1-1a)
2. External respiration. (para 1-1a)
3. Internal respiration. (para 1-1a)
4. Breathing. (para 1-1b)
5. Costal; diaphragmatic. (para 1-1b)
6. Larynx; infralaryngeal. (para 1-2b(1) through (3))
7. Air cells or cavities in the skull. (para 1-3a(2)(d))
8. Upper nasal chambers; sense of smell. (para 1-3a(2)(c))
9. Internal nose. (para 1-3a(2))
10. Nasopharynx, oropharynx, laryngopharynx. (para 1-3b(2))
11. Cricoid. (para 1-4a(3))
12. Thyroid. (para 1-4a(1))
13. The alveoli of the lungs. (para 1-5a)
14. Tubular; alveoli. (para 1-5c)
15. Pleura. (para 1-9)
16. Respiratory center. (para 1-14a)
17. Cardiac failure; decreased rate of respiration. (para 1-15a, b, c)
18. The body is expelling carbon dioxide that has been formed as the body cells work and use up oxygen. (para 1-16c)
19. 6,000. (para 1-17a)
20. The volume of air that can be expelled after a full inspiration. (para 1-17e)
21. Make the transfer of gases possible. (para 1-5b)
22. Diaphragm. (para 1-6)

End of Lesson 1

LESSON ASSIGNMENT

LESSON 2	Physical Assessment of the Respiratory System.
LESSON ASSIGNMENT	Paragraphs 2-1 through 2-8.
LESSON OBJECTIVES	After completing this lesson, you should be able to:
	2-1. Perform the preliminary steps in physical assessment of the respiratory system.
	2-2. Perform these examination techniques: inspection, palpation, percussion, auscultation.
SUGGESTION	After completing the assignment, complete the exercises at the end of this lesson. These exercises will help you to achieve the lesson objectives.

LESSON 2

PHYSICAL ASSESSMENT OF THE RESPIRATORY SYSTEM

Section I. GENERAL APPROACH TO PHYSICAL ASSESSMENT

2-1. PATIENT'S HISTORY

The patient's history, obtained by interviewing him, is the patient's view of his health problems, general health condition, past medical history, family health history, and profile of his personal and social life and well-being. Additionally, the patient's history will show information the patient knows about his health, what is important in terms of health care, and what he expects from the health care being asked for. Since the interviewer is getting the information from the patient rather than observing him directly, the patient history information is subjective information. Be sure to record this information immediately and in an organized manner.

2-2. CONDITIONS

The patient should be undressed to the waist. Be sure the examination is conducted in a room with good light.

2-3. PROCEDURE

a. Working from the top of the patient's body down, perform the examination systematically from the head to the foot. In this way, you will be thorough and not miss anything.

b. Compare the findings on one side of the body with the findings on the other side of the body. In many instances, the body is bilaterally symmetrical; that is, the left side of the body has many of the same parts as the right side of the body. The parts are arranged as if the right side had been turned over.

c. Throughout the examination, try to visualize the structure of the body parts underneath the tissues. In each region of the body, consider the function of the body parts and be alert for any abnormalities.

d. Examine the patient's posterior thorax and lungs while he is in the sitting position. The patient's arms should be folded across his chest so that the scapulae (the shoulder blades) are partly out of the way. Then ask the patient to lie down while you examine his anterior thorax and lungs.

2-4. FUNCTIONS OF THE PHYSICAL ASSESSMENT

There are four functions (or parts) of the physical assessment: inspection, palpation, percussion, and auscultation. When you are doing a physical assessment, perform these functions in the order just given. The definition of each function is given in figure 2-1.

INSPECTION	=	Looking at the patient and observing the patient's behavior and body.
PALPATION	=	Touching the patient's body and noting what the various structures and parts of the body feel like.
PERCUSSION	=	Striking parts of the patient's body with short, sharp blows, and listening to the sounds of the body parts underneath the tissues.
AUSCULTATION	=	Using the stethoscope to listen to sounds in the body.

Figure 2-1. Techniques of examination/assessment.

Section II. STEPS OF THE PROCEDURE

2-5. INSPECTION

Inspection, the most important of the examination techniques, begins with the first moment you see the patient. Begin each portion of the examination by looking at the part of the body you are examining.

a. **The Patient**. The patient should be calm, relaxed, and not unduly apprehensive.

b. **Breathing**. Observe the patient for these aspects of breathing:

(1) Respiratory rate. The respiratory rate should be between 12 and 20 breaths per minute with even and easy movements of the respiratory muscles and chest expansion.

(2) Rhythm. Note the rhythm of the patient's breathing.

(3) Breathing. Note whether or not it is an effort for the patient to breath.

c. **Skin**. Look at the color of the patient's skin and check for bruises and/or lacerations.

d. **Chest**. Observe the shape of the patient's chest. The chest should be bilaterally symmetrical.

e. **Respirations**. Respirations should be the result of movement of the diaphragm.

2-6. PALPATION

Palpation is touching the part of the patient's body you have just inspected and becoming sensitive to what that body part feels like. It is possible to feel an abnormal from a normal body part.

a. **Four Uses for Palpation of the Chest**.

(1) Identify areas of tenderness. Any area where the patient has reported pain or where there are lesions (a hurt, injury, wound) should be palpated.

(2) Assess observed abnormalities. If you have seen masses or sinus tracts (blind, inflammatory, tube-like structures opening into the skin), palpate the area to evaluate the problem further.

(3) Further assess the respiratory excursion. Determine the range of respiratory movement (how far the chest expands when he inhales and how far the chest contracts when he exhales). You can also feel symmetry of respiratory movement (whether or not the body parts feel the same on both sides during a respiration).

REMEMBER: 1 RESPIRATION = 1 INHALATION + 1 EXHALATION

(4) Elicit tactile fremitus. When a person speaks, vibrations that can be felt are transmitted through the bronchopulmonary system to the chest wall. These vibrations can best be felt when a person says the words "ninety-nine" or "one-one-one." Ask the person to speak louder or lower his head if you cannot feel the vibrations.

b. **Finger Placement**. Place your finger pads on the skin surface over the area you are palpating. Do not move your fingers over the skin surface during palpation. Palpation should reveal a chest free from pain, tenderness, lesions, and masses. The wall should be firm with no indication of rib fractures or abscesses. The trachea will be midline; a deviated trachea is abnormal. Palpation of the respiratory excursion (respiration at rest position) should reveal an even, symmetrical movement of the chest.

c. **Assessment of Respiratory Excursion**.

(1) Posterior (figure 2-2).

(a) Place your thumbs about the level of and parallel to the 10th rib, your hands grasping the lateral rib cage.

(b) As you position your hands, slide them medially in order to raise loose skin folds between your thumbs and the patient's spine.

(c) Feel for range of symmetry of respiratory movement.

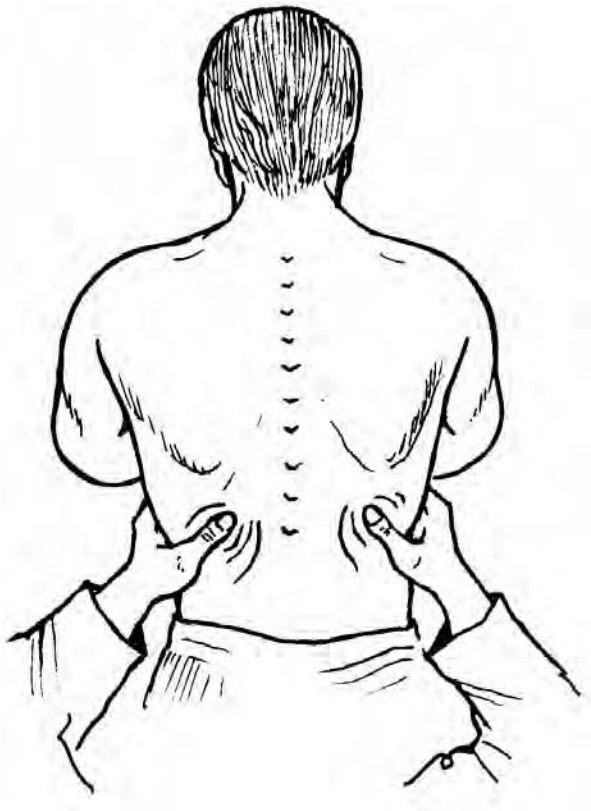

Figure 2-2. Posterior palpation.

(2) Anterior (figure 2-3).

(a) Place your thumbs along each costal margin with your hands along the lateral rib cage.

(b) As you position your hands, slide them medially a bit to raise a loose skin fold between the thumbs.

(c) Ask the patient to inhale deeply.

(d) Watch for your thumbs to separate as the thorax expands.

(e) Feel for the range and symmetry of respiratory movement.

Figure 2-3. Anterior palpation.

d. **Palpate the Chest for Tactile Fremitus** (figure 2-4). Fremitus refers to the palpable vibrations transmitted through the lungs to the chest wall when the patient speaks. Have the patient say "ninety-nine" or "one-one-one" and you will feel vibrations. Vibrations are more difficult to feel over bone. NOTE: Patients with a heavy layer of fat may need to speak more loudly for you to feel the vibrations.

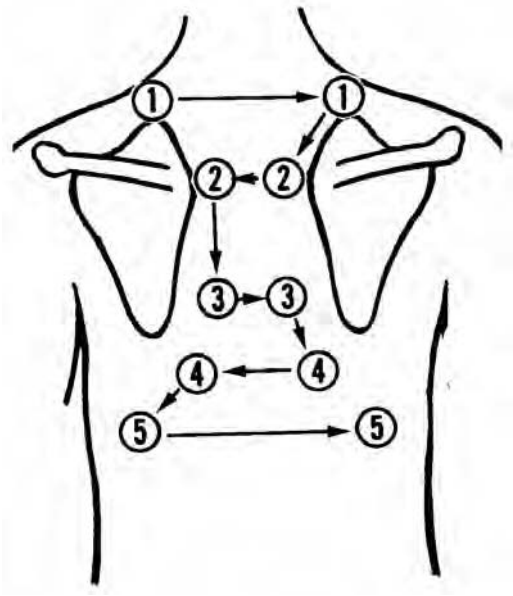

Figure 2-4. Sequence of tactile fremitus examination.

e. **Follow this Procedure to Palpate Properly.**

(1) Use the ball of the hand (the palm of the hand at the base of the fingers), palpate and compare like areas of the lungs. To be more accurate, use only one hand rather than both hands. Do not let your fingers touch the patient's chest.

(2) Have the patient repeat a sound that will make full and rich sounds such as "ninety-nine" or "one-one-one." Symmetrically move your hand over the patient's chest.

(3) You should feel vibrations of equal intensity on either side of the patient's chest.

(4) Normally, you will feel fremitus on the upper chest, close to the bronchi.

(5) Also, normally, you should feel little or no fremitus in the lower chest.

(6) Compare like (symmetrical) areas of the lungs.

f. **Diaphragm Level** (figure 2-5). The level of the diaphragm can be estimated roughly by noting where fremitus stops upon the downward palpation of the chest. It is normal to find that the right side of the diaphragm is slightly higher than the left side.

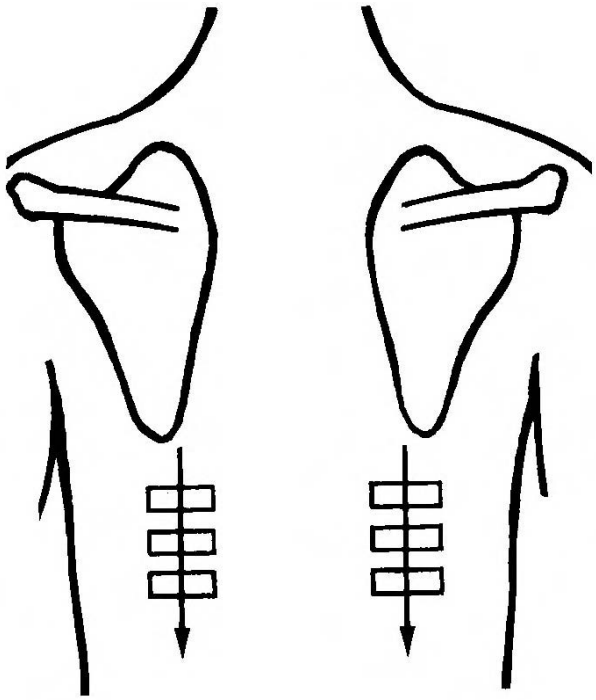

Figure 2-5. Diaphragm level.

2-7. PERCUSSION OF CHEST

To perform a percussion examination, strike the surface of the body. When this is done, various sounds can be heard. The sounds are different depending on the underlying structure of the body. There are two reasons to use percussion as an examination technique. First, percussion results in setting the chest wall and underlying tissues in motion. This produces sounds that can be heard. Second, percussion sounds can be divided into four recognizable notes. Train your ear to recognize the pitch and duration of these notes. The sound can indicate whether the underlying tissues are filled with air, filled with fluid, or solid. NOTE: Percussion will set tissues in motion only about five to seven centimeters into the chest, so the percussion examination technique is not a way to detect lesions that are very deep.

	Intensity	Pitch	Duration	Example Location
Flatness	soft	high	short	thigh
Dullness	medium	medium	medium	liver
Resonance	loud	low	long	normal lung
Tympany	loud	"musical timbre"		gastric air bubble or puffed out cheek

Table 2-1. Table of percussion notes.

a. **Procedure**. In order to perform the percussion examination technique, strike the stationary finger of one hand with a flexed finger of the other hand. The technique, described here, can be practiced on any surface. Here are the key points:

(1) Firmly rest the first joint of the middle finger of one hand on the patient's chest, but don't let the rest of the hand touch the chest (figure 2-6).

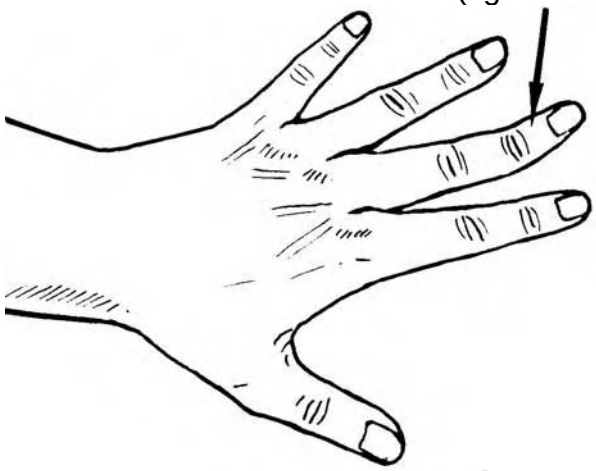

Figure 2-6. Hand and finger placement.

(2) Keep the fingers of the other hand flexed and the wrist loose (figure 2-7).

Figure 2-7. Hand position.

(3) With the tip of the middle finger of the flexed hand, strike the first joint of the middle finger of the hand that is on the patient's chest (figure 2-8). Have the motion come from the wrist.

Figure 2-8. Striking position.

(4) Withdraw the striking finger immediately to avoid damping the vibration.

(5) Strike once or twice, then move your hands symmetrically to another part of the chest.

b. **Areas of Percussion**.

(1) Ideally, the patient should lie in the supine position (lying on the back, face upward) for percussion on the front of the chest. The patient should be sitting up for percussion on the back.

(2) If the patient is ill and unable to sit up, examine with the patient lying on the right or left side.

(3) Percuss the patient's anterior chest (figure 2-9). In a healthy patient, the entire upper chest is resonant except for the area of cardiac dullness. Percuss across the top of the body and work downward, symmetrically.

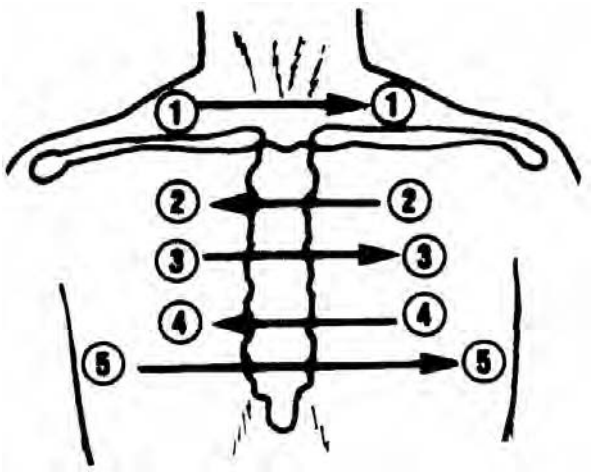

Figure 2-9. Anterior percussion.

(4) Percuss the patient's posterior chest, symmetrically down the chest wall making a side to side comparison (figure 2-10). Percussion over lung fields should reveal equal bilateral findings. Omit percussion over the shoulder blades.

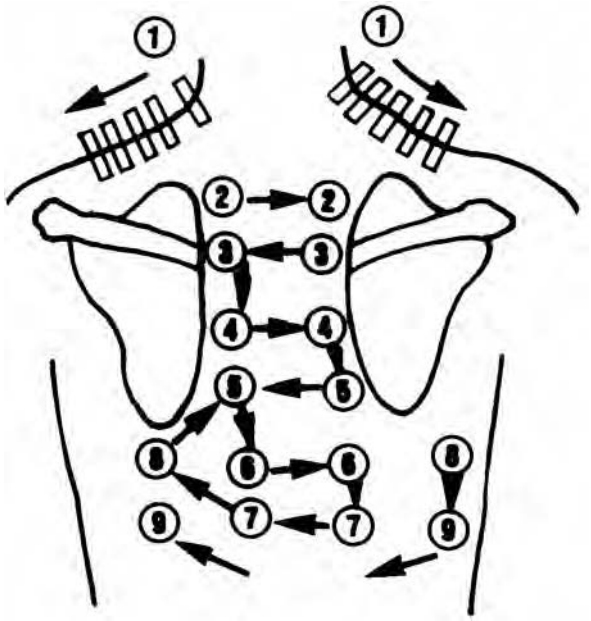

Figure 2-10. Posterior percussion.

(5) Measure the diaphragmatic excursion (movement of the diaphragm from a position of rest) by noting the difference between the levels of dullness when the person inhales fully and exhales fully. See figure 2-11. The difference is normally about 5 or 6 cm.

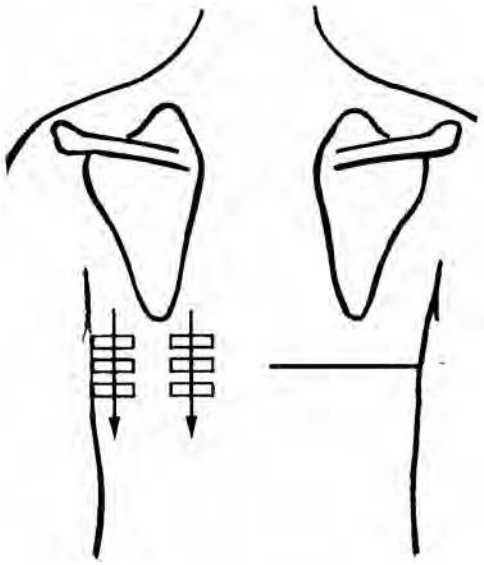

Figure 2-11. Diaphragmatic excursion.

2-8. AUSCULTATION OF CHEST

Auscultation (listening with a stethoscope) of the lungs is useful in estimating the airflow through the tracheobronchial tree, detecting an obstruction, and assessing the condition of the surrounding lungs and the pleural space.

a. Position the patient. Have the patient sitting or in a supine position. When the patient is lying down, examine his back by turning the patient from side to side.

b. Show the patient how you want him to breath through the mouth, deeper and more forcefully than usual.

c. Listen with the stethoscope.

(1) Start at the top of the back and work downward, comparing the right and the left sides.

(2) Then, start at the top of the chest and work downward, comparing symmetric points sequentially.

(a) Listen to one full breath in each location.

(b) Be alert for patient discomfort--light-headedness, faintness--that signals hyperventilation.

d. Auscultate normal breath sounds**.** Auscultate (examine by listening) normal breath sounds in accordance with table in 2-2.

NOTE: Two normal breath sounds can be auscultated as follows:

	Duration of inspiration and expiration	Pitch of expiration	Intensity of expiration	Sample location
vesicular breath sounds	inspiration greater than expiration	low	soft	most of lungs
bronchial or tubular breath sounds	expiration greater than inspiration	high	usually loud	over the trachea

Table 2-2. Auscultated normal breath sounds.

e. Auscultate vesicular breath sounds (figure 2-12). These sounds are normally heard over the entire lung surface, except beneath the manubrium sterni and in the interscapular region. The sounds are long when the patient inhales and short when the patient exhales.

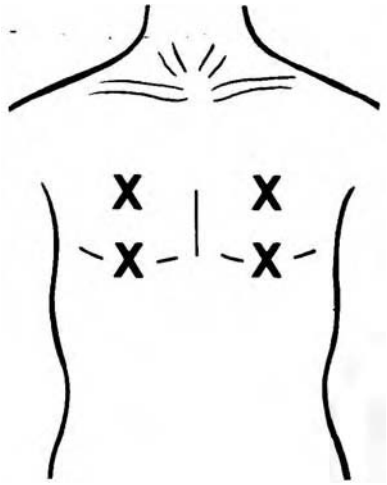

Figure 2-12. Auscultation over lung surfaces.

f. Auscultate bronchial (tubular) breath sounds (figure 2-13) . These sounds result from consolidation or compression of the pulmonary tissue that assists in the transmission of sound from the bronchial tree. Bronchial breath sounds do not occur in the normal lung except directly over the trachea. These sounds are short when the person breathes in and long when the person breathes out. The sounds are usually louder than vesicular breath sounds. .

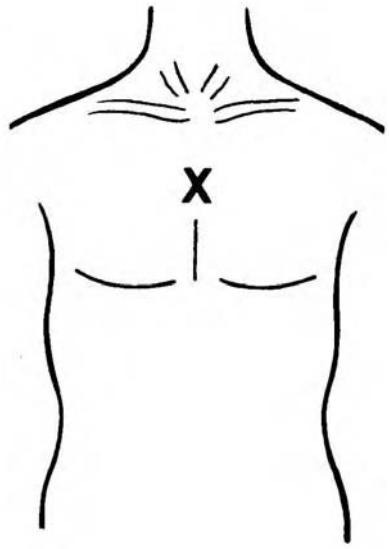

Figure 2-13. Auscultation over the trachea.

g. Check for abnormal sounds. Check for sounds in the lungs that are not modifications of breath or voice.

(1) Rhonchi. These are coarse, rattling sounds produced when the patient exhales. The sounds are usually very clear but might change with coughing. Low-pitched, these sounds occur when there is mucus in the bronchi.

(2) Rales (Crackles). Rales, also called crackles, are fine, rattling sounds. These are noncontinuous, high-pitched, fine crackles, like the sound of carbonated beverages. The sounds are usually heard when the patient breathes in and sometimes when the patient begins to exhale. These sounds are usually caused by the presence of fluid in the alveoli and the bronchioles. Sometimes the fluid is in these parts of the respiratory system, and sometimes the fluid is not there. This is the reason that sometimes the fine rattling can be heard, and sometimes it is not heard. Coughing usually makes the sounds louder.

(3) Wheezes. Wheezes are musical sounds like the high-pitched notes on a clarinet. Wheezes are produced by constricted or partially obstructed airways. The sounds can be heard when the patient breathes in.

(4) Pleural friction rub. These are scratchy sounds like crinkling Saran™ wrap. The sounds are produced by the movement of inflamed pleural surfaces rubbing together.

Continue with Exercises

EXERCISES, LESSON 2

INSTRUCTIONS. Answer these exercises by writing the answer in the space provided. After you have answered all the exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers.

1. The four techniques used in examining a patient are:

   a. _____.

   b. _____.

   c. _____.

   d. _____.

2. The patient's respiration rate should be _____to _____ breaths per minute.

3. List three things to observe when you are inspecting the patient.

   a. _____.

   b. _____.

   c. _____.

4. When you are inspecting a patient, look at the skin and check for _____

   and _____.

5. During an inspection examination, observe the chest to see if it is shaped

   _____.

6. List four uses of palpation of the chest.

   a. _____.

   b. _____.

   c. _____.

   d. _____.

7. During palpation, your fingers should not _____.

8. When you are performing a palpation examination, it is normal to find that the _____ side of the diaphragm is slightly higher than the _____ side.

9. List two reasons to perform chest percussion.

   a. _____.

   b. _____.

10. List two uses of examination of the chest by auscultation.

    a. _____.

    b. _____.

11. Coarse rattling sounds produced when the patient coughs are called _____.

12. Musical sounds like the high-pitched coughs are called _____.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES, LESSON 2

1. Inspection.
   Palpation.
   Percussion.
   Auscultation. (para 2-4)

2. 12 to 20 (para 2-5b(1))

3. Respiration rate.
   Rhythm of breathing.
   Effort of breathing. (paras 2-5b(1)-(3))

4. Bruises and lacerations. (para 2-5c)

5. Symmetrically. (para 2-5d)

6. Identify areas of tenderness.
   Assess observed abnormalities.
   Further assess respiratory system.
   Elicit tactile fremitus. (paras 2-6a(1)-(4))

7. Move over the skin surface. (para 2-6b)

8. Right; left. (para 2-6f)

9. Set the chest wall and underlying tissues in motion to produce sounds that can be heard.

   These sounds can be used to help decide if the underlying tissues are filled with air, fluid, or a solid. (para 2-7)

10. You are correct if you listed any two of the following:

    Estimating airflow through the tracheobronchial tree.
    Detecting an obstruction.
    Assessing condition of the lungs and pleural space. (para 2-8)

11. Rhonchi. (para 2-8g(1))

12. Wheezes. (para 2-8g(3))

End of Lesson 2

LESSON ASSIGNMENT

LESSON 3	Infectious Respiratory Diseases.
LESSON ASSIGNMENT	Paragraphs 3-1 through 3-15.
LESSON OBJECTIVES	After completing this lesson, you should be able to:

3-1. Identify the characteristics, signs/symptoms, and treatment for these upper respiratory diseases: allergic rhinitis; paranasal sinusitis; common cold; acute pharyngitis; acute tonsillitis/strep throat.

3-2. Identify the characteristics, signs/symptoms, and treatment for these upper respiratory diseases with systemic effects: mononucleosis; influenza.

3-3. Identify the characteristics, signs/symptoms, and treatment for these types of pneumonia: staphylococcal pneumonia; mycoplasmal pneumonia; viral pneumonia; bronchial pneumonia.

SUGGESTION After completing the assignment, complete the exercises at the end of this lesson. These exercises will help you to achieve the lesson objectives.

LESSON 3

INFECTIOUS RESPIRATORY DISEASES

Section I. UPPER RESPIRATORY DISEASES

3-1. ALLERGIC RHINITIS

a. **Definition/Characteristics**. Allergic rhinitis may be defined as the inflammation of nasal mucosa brought about by airborne pollens that react to release histamine. In other words, when some people breathe pollens that are in the air, the pollens cause histamine to be released. The excess of histamine in the body causes nasal mucosa to become inflamed. Causes of allergic rhinitis, more common during the warmest months of the year, include hay fever and allergic disorders which are common during seasons when the pollen count is high. Allergicrhinitis is also caused by house dust, occupational dust, molds, and animal danders (feathers, wool in blankets). Certain foods and drugs cause allergic rhinitis symptoms; sometimes bacteria cause this problem.

b. **Signs/Symptoms.**

(1) Nasal congestion.

(2) Profuse watery discharge.

(3) Itching of nose and conjunctiva.

(4) Sneezing.

c. **Treatment.** Treatment may include a combination of antihistamines, decongestants, or desensitization as well as management. Elimination of house dust, pollens, and such may bring relief to the patient's symptoms.

(1) Antihistamines. For the majority of patients, antihistamines will not only control the symptoms of allergic rhinitis but also dry out the membranes. Caution: Antihistamines cause some persons to be sedated, depressed, sleepy, or uncoordinated. Watch for these reactions.

(2) Decongestants. Give decongestants if the patient suffers from nasal obstruction. Decongestants are effective for short-term but not long-term treatment.

(3) Desensitization. Several months before the season when the individual becomes acutely uncomfortable from pollen, give injections of pollen extracts that are specifically made for the individual. Continue giving the injections once a week during the peak of the pollen season.

3-2. PARANASAL SINUSITIS

a. **Definition/Characteristics.** Paranasal sinusitis is an infection of the mucous membranes that line the paranasal sinuses. Since the membrane that lines these sinuses is continuous with that of the nose and throat, paranasal sinusitis is a common complication of any upper respiratory infection. Causes of paranasal sinusitis include viruses, streptococci, and pneumococci.

b. **Signs/Symptoms.** Signs and symptoms of acute paranasal sinusitis are like those of acute rhinitis but are more severe. Included are headache, worse during the day; facial and tooth pain; tenderness over the sinuses; and fever and chills. There may be chronic recurrences of these signs and symptoms along with postnasal drip.

c. **Treatment.** The goals of treatment are to improve drainage and control infection. Vasoconstrictors such as steam inhalation and phenylephrine 0.25 percent spray used three times a day for a maximum of seven days may be used to open the nasal passages. In the case of acute paranasal sinusitis, antibiotics may be given. The drug of choice is penicillin G. If the patient is allergic to penicillin, erythromycin is an alternative drug. Patients suffering from chronic paranasal sinusitis may be given ampicillin or tetracycline.

d. **Complications.** Possible complications from paranasal sinusitis include osteomyelitis (inflammation of the bone marrow); meningitis (inflammation of the membranes covering the brain and spinal cord); and abscess.

3-3. COMMON COLD

a. **Definition/Characteristics.** The common cold is a contagious, viral infection of the upper respiratory tract. The cold is usually caused by a strain of rhinovirus. Over ninety distinct strains of rhinovirus are known to cause the common cold. Although not everyone is susceptible to infection from a cold virus, this respiratory infection occurs more often than all other diseases combined. Whether or not a person develops a cold after being exposed to a cold virus is determined to some extent by the person's general health. Fatigue, chilling of the body, wearing wet clothes and shoes, and the presence of irritating substances in the air make it more likely that the person will develop a cold.

b. **Signs/Symptoms.** These are signs and symptoms of the common cold:

(1) Malaise (general feeling of being unwell).

(2) Fever/chills.

(3) Headache.

(4) Nasal discomfort.

(5) Dry, sore throat.

(6) Cough (either productive or nonproductive).

(7) Mild leukocytosis (temporary increase in number of leukocytes in the blood).

c. **Treatment.** The patient should rest, drink fluids, take analgesics for pain, and use nasal decongestants for stuffiness in the nasal passages.

3-4. ACUTE PHARYNGITIS

a. **Definition/Characteristics.** Acute pharyngitis is an inflammation of the pharynx. This disease, inflammation of the mucosa of the pharynx, usually occurs as part of an upper respiratory tract disorder. The nose, sinuses, larynx, and trachea may also be affected. The most common causes are bacterial and viral infection. Very rarely, acute pharyngitis is caused by inhalation of irritant gases or ingestion of irritant liquids. Sometimes, acute pharyngitis is one symptom of a specific disease such as measles, chickenpox, scarlet fever, or whooping cough.

b. **Signs/Symptoms.** Common signs and symptoms are listed below. A complication may be a secondary infection.

(1) Dry and sore throat.

(2) Fever.

(3) Malaise.

(4) Strep infection may be present with white pus pocket formation.

(5) Cough.

c. **Treatment.** Rest, light diet, analgesics for pain, and nonirritating gargles (saline) should relieve the symptoms. Give antibiotics for initial or complicating bacterial infection.

3-5. ACUTE TONSILLITIS/STREP THROAT

a. **Definition/Characteristics.**

(1) Tonsillitis. Tonsillitis is a painful disease caused by bacteria or viruses that infect one or both of the palatine tonsils. People between the ages of 10 and 40 have the majority of tonsillitis attacks.

(2) Strep throat. Strep throat is an infectious disease that affects the membranes of the throat and tonsils. This disease is also called septic sore throat, acute streptococcal pharyngitis, and acute streptococcal tonsillitis. The disease is caused by group A beta-hemolytic streptococci bacteria. It spreads from person to person through droplets of moisture sprayed from the nose and mouth. Some people only carry the bacteria. These carriers exhibit no symptoms themselves, but spread the disease.

b. **Signs/Symptoms.**

(1) Sore throat.

(2) Strong breath odor.

(3) Pain on swallowing.

(4) Fever/chills.

(5) Posterior cervical lymphadenopathy (disease of the lymph nodes).

(6) Headache.

(7) Malaise.

(8) Red or swollen tonsils or pharynx (with or without fluid, cells, or cellular debris from blood vessels [exudates]).

(9) Increased white blood cells with bacterial pharyngitis.

(10) With bacterial pharyngitis (strep throat), the throat culture is positive.

c. **Complications.** Chronic tonsillitis, acute otitis media (accumulation of fluid in the middle ear), and acute sinusitis are complications which may occur as a result of tonsillitis or strep throat.

d. **Treatment.** Treatment includes rest, fluids, light diet, saline (salt water) gargles, and analgesics for pain. If indicated, prescribe antibiotics.

(1) Penicillin VK 250 mg, 1 tablet by mouth 6 times a day for 10 days.

(2) An alternate drug is erythromycin in the dosage of 250 mg. Take 1 tablet by mouth 6 times a day for 10 days.

(3) If the patient has difficulty swallowing, give benzathine penicillin G (bicillin), 1.2 million units intramuscularly.

Section II. UPPER RESPIRATORY DISEASES WITH SYSTEMIC EFFECTS

3-6. MONONUCLEOSIS

a. **Definition/Characteristics.** Characterized by the presence of more than the normal number of mononuclear leukocytes in the blood, mononucleosis gets its name from these mononuclear (single nucleus) cells. Although this disease occurs mostly in young adults, children and older people do sometimes contract mononucleosis. One of the herpes viruses, the Epstein-Barr virus, is the cause. The disease can be spread by direct contact between people--kissing, for example. A simple blood test can determine whether a person has mononucleosis. Some sheep's blood is mixed with a sample of clear liquid of the patient's blood. If the patient has mononucleosis, the sheep's blood cells will stick to one another.

b. **Signs/Symptoms.** The following signs and symptoms may be present:

(1) Fever.

(2) Malaise.

(3) Sore throat.

(4) Hepatic (liver) dysfunction.

(5) Lymphadenopathy (may cause lymph node enlargement).

(6) Hepatosplenomelegaly (enlargement of the liver and spleen).

(7) Abnormal lymphocytes.

(8) Marked asthenia (weakness).

c. **Treatment.** There is no specific treatment for mononucleosis. Generally, rest and nourishment are prescribed. Specific symptoms are treated; for example, saline gargles for sore throat and analgesics for pain. Secondary infections are treated with appropriate antibiotics. Strenuous activities should be avoided.

d. **Precautions.** The symptoms of hepatitis and respiratory occlusion are treated. If the spleen ruptures, emergency removal of the spleen may be necessary.

3-7. INFLUENZA

a. **Definition/Characteristics.** Influenza is a highly contagious disease caused by a virus. The disease spreads by an infected person exhaling the virus, which is then breathed in by an uninfected person. Once inhaled, the virus comes in contact with cells of the upper air passages, and new influenza viruses are released in the body. These viruses infect other cells along the respiratory tract sometimes spreading deep within the lungs and to other parts of the body. The formerly healthy person exhales viruses that may be carried away by the air to be inhaled by someone else. Several different strains of virus including A, B, C, and swine viruses infect people. When the body produces substances called antibodies, people develop immunity or resistance to influenza. The antibodies attach themselves to influenza viruses and prevent the viruses from infecting cells. It is possible for the virus to change its chemical composition so that the antibodies no longer work. When this happens, the cells of the body must form new antibodies.

b. **Signs/Symptoms.** The onset of signs and symptoms is usually sudden and can include the following:

(1) Slight fever lasting 1 to 7 days (usually 3 to 5 days).

(2) Cough which is nonproductive and dry, occurring in spasms.

(3) Headache.

(4) Nasal stuffiness and discharge.

(5) Mildly infected throat.

(6) Chills.

(7) Myalgia (pain in muscles).

(8) Occasional nausea, diarrhea.

c. **Complications.** These complications can occur:

(1) Necrosis of the respiratory epithelium (tissue death of linings in the respiratory system) which makes a secondary bacterial infection possible.

(2) The most common complication is pneumococcal pneumonia.

(3) The most serious complication is a staphylococcal infection.

d. **Diagnosis.** Isolation of the virus from throat washing or sputum allows a diagnosis of influenza.

e. **Treatment.** Bed rest is of great importance in order to prevent complications. Analgesics can be taken for muscle pain and headache. The patient should drink plenty of fluids. Antibiotics may be given for secondary bacterial infections.

f. **Prevention.** Flu vaccine is available for vaccination of the general population.

Section III. LOWER RESPIRATORY DISEASES

3-8. ACUTE BRONCHITIS

a. **Definition/Characteristics.** Acute bronchitis is inflammation of the bronchial mucous membrane of the bronchial tree. Infection, dust, chemical agents, and/or allergies can cause bronchitis. When the bronchi are infected, the mucous membranes (linings) of the bronchi secrete mucus and pus cells (white blood cells that can attack infectious agents). The large outpouring of mucus partially obstructs the airways. Additionally, the irritated membranes may swell, further obstructing the airways.

b. **Signs/Symptoms.**

(1) Chilliness.

(2) Malaise.

(3) Soreness and constriction behind the sternum-worse when patient coughs.

(4) Slight fever.

(5) Cough, at first dry and painful; later, green or yellowish sputum with pus cells.

c. **Treatment.** Treatment should include bed rest and increased fluid intake. Medication to reduce the fever and pain can be taken. Antibiotics can be used, if indicated. Steam inhalation can open air passages.

3-9. PLEURITIS

a. **Definition/Characteristics.** Pleuritis is an inflammation of the pleural lining, a lining that covers the lungs and the chest cavity. The two surfaces of this lining are moist and allow the lungs to move smoothly over the chest wall when a person breathes. The surfaces of the lining become dry and rough. They rub together when the pleura lining is inflamed. This condition, called pleurisy or pleuritis, is very painful and becomes more painful when the person breathes deeply or coughs. Most cases of pleuritis occur as complications of some other respiratory condition such as pneumonia, tuberculosis, or another infectious disease. The underlying disease must be treated in order to cure the pleuritis.

b. **Signs/Symptoms.** Pleuritis signs and symptoms include the following.

(1) Pain--varies from vague discomfort to sharp severe stabbing in the chest. The pain becomes worse when the person coughs or breathes deeply.

(2) Respirations--short, shallow, and rapid.

(3) Motion--limited on the affected side.

(4) Breath--diminished sound.

(5) Fever.

(6) Chills.

(7) Friction rub--usually heard only after 24 to 48 hours.

c. **Treatment.** The patient should rest in bed, use heat on the area that is painful, and take analgesics for fever and mild pain.

3-10. PNEUMONIA

a. **Characteristics/Definition.** Pneumonia is an acute infection of the alveoli spaces of the lungs. Causes of pneumonia include injury to the respiratory mucosa with pneumonia as a secondary infection, influenza, common colds, and bronchitis. There are three types of pneumonia: bacterial, mycoplasmal (bacteria having no cell wall and bounded by a triple-layered membrane), and viral. Bacterial pneumonia is further subdivided into these types: pneumococcal; staphylococcal; klebsiella (Friedlander's bacillus); streptococcal; and influenza bacillus.

b. **Pneumococcal Pneumonia.** Sixty to eighty percent of bacterial pneumonia cases are pneumococcal pneumonia. This type of pneumonia, an inflammation of the lung tissue, is probably caused by a lowering of a person's natural resistance to

infection. These conditions that can lower a person's resistance to this type of pneumonia include viral respiratory diseases, malnutrition, exposure to cold, exposure to noxious gases, and alcoholic intoxication.

(1) Signs/Symptoms.

(a) Mild nasopharyngitis (inflammation of the nasopharynx)--several days before onset of the disease.

(b) Sudden onset of illness.

(c) Vomiting.

(d) Severe chest pain (occurs in 70 percent of the cases).

(e) Productive cough with rusty sputum.

(f) Fever (103ºF to 106ºF) and chills.

(g) Often acutely ill.

(h) Dyspnea (labored breathing) and cyanosis. Cyanosis in light-skinned individuals gives a bluish cast to skin, lips, and nail beds. In dark-skinned individuals or blacks, the discoloration is grey or grayish. The cause is not enough oxygen in the blood.

(i) Decreased movement on one side of the chest.

(j) Severe, shaking chill.

(k) Signs of consolidation (inflammatory solidification of the lung); dull to percussion; bronchial breath sounds; fine rales.

(l) Gram-positive diplococci (bacterium which has not separated but occurs in pairs as a result of disease).

(m) Blood culture positive.

(n) Chest x-rays originally showing vague haziness but later showing shadows in area of lung involvement.

(2) Course. Fever and symptoms subside dramatically within 72 hours after the start of the antibiotics in over fifty percent of the patients. When the patient begins to get better, the fine rales and tubular breathing become coarse, sticky rales. If the patient experiences pseudocrisis (the fever subsides, but the other symptoms continue), watch for shock.

(3) Treatment.

(a) The drug of choice is penicillin given by intramuscular injection. The dosage ranges from 600,000 units of procaine penicillin every 12 hours if the illness is moderate to 1 million units of aqueous penicillin G given every 4 hours in an intravenous infusion for a patient seriously ill. Continue penicillin treatment 72 hours after the patient's temperature has returned to normal. If the patient is allergic to penicillin, administer tetracycline or erythromycin.

(b) The patient should have bed rest, oxygen, fluids, and electrolytes. In two to three weeks, the patient should have a follow-up chest x-ray.

(4) Prognosis. In treated groups, there is 95 percent recovery. In groups of people who are untreated, 20 to 40 percent do not survive (usually in the under 2 age group and the over 45 age group).

Section IV. OTHER CAUSES OF PNEUMONIA

3-11. INTRODUCTION

Other causes of pneumonia include other bacteria, viruses, mycoplasmas, pulmonary embolus, and atelectasis. The physical findings and x-ray evidence may be similar. In order to treat a pneumonia case properly, it is important to determine the cause by blood culture and sputum examination. Occasionally, other methods may be necessary to determine the cause.

3-12. STAPHYLOCOCCAL PNEUMONIA

a. **Predisposing Factors.** A person with a respiratory tract viral infection can contract this type of pneumonia. A debilitated patient such as a postsurgical patient also may contract staphylococcal pneumonia.

b. **Signs/Symptoms.** Signs of consolidation (dullness and tubular breathing) are infrequent, but pleural effusion (liquid in the pleural space) is common. Gram-positive cocci (bacterial cells) help confirm that the patient has staphylococcal pneumonia.

c. **Treatment.** Initial treatment consists of a vigorous antibiotic which should be a penicillin derivative other than penicillin G or ampicillin. If the patient is sensitive to penicillin, the next drug of choice would be cephalothin given for 8 to 14 days and administered intravenously or vancomycin twice a day administered intravenously.

d. **Prognosis.** There is 15 to 20 percent mortality. Whether or not the patient recovers depends on his underlying general health and the effect of the drug administered on the virus.

3-13. MYCOPLASMAL PNEUMONIA

Mycoplasmas can be defined as bacteria that do not have a cell wall. Mycoplasma pneumonia is a respiratory, disease-producing microorganism that occurs from time to time and spreads in groups of people--the family, school populations, the military.

a. **Signs/Symptoms.**

(1) Slow onset of headache and malaise.

(2) Cough, nonproductive or a small amount.

(3) Not acutely ill.

(4) No cyanosis or dyspnea.

(5) Only mild signs of consolidation.

(6) Shadows on the chest x-ray.

(7) White blood count is normal.

(8) Gram stain shows normal flora (flora-normal bacteria in intestine).

(9) Frequently affects families.

(10) Generally, limits itself.

(11) Cold agglutinins positive (50 percent or more).

b. **Treatment.** Follow the same general measures as for pneumococcal pneumonia. Antimicrobial drugs are not necessary in mild or moderate cases of this disease. In severe cases, tetracycline or erythromycin may be given for two or three weeks.

3-14. VIRAL PNEUMONIA

Viral pneumonia may be caused by the adenoviruses (a group of DNA viruses, some of which can cause respiratory tract infections), respiratory viruses, the parainfluenza viruses, and probably other viruses not yet identified with viral pneumonia. It is difficult to distinguish viral pneumonia from primary atypical pneumonia on the basis of physical and x-ray findings. It is necessary to examine sputum by Gram's stain and culture to diagnose viral pneumonia.

a. **Signs/Symptoms.** The onset of viral pneumonia is usually slow and occurs after an upper respiratory infection. The disease is similar to mycoplasmal pneumonia except that the illness is shorter and cold agglutinins and lymphocytosis are negative. The disease, however, is dangerous to two groups of people: debilitated persons with chronic pulmonary or cardiac disease and infants under six months. For these patients, the disease is rapid and often fatal. The signs of the disease are much like those for pneumococcal pneumonia. Other signs and symptoms for persons not in these two high risk groups include:

(1) Mild rales.

(2) Nonproductive cough.

(3) Mild illness.

(4) Abnormal chest x-ray, rarely.

b. **Treatment.** Treatment is supportive in that the symptoms should be treated. No antibiotics are given.

3-15. BRONCHIAL PNEUMONIA

Bronchial pneumonia is an infection of the alveolar spaces of the respiratory bronchiole.

a. **Signs/Symptoms.** Bronchial pneumonia begins slowly, often after a person has had an upper respiratory infection. The patient may cough and spit out greenish, yellowish sputum. The patient's chest may be congested and feel tight, yet a percussion examination will be normal. Auscultation indicates the patient has scattered rhonchi, usually on both sides of the chest. His respiration, pulse, and temperature will be above normal.

b. **Treatment.** Treat the symptoms of the disease. Specific problems can be treated with drugs. A patient with mycoplasmal pneumonia can be given tetracycline. Administer penicillin to patients with either pneumococcal or streptoccal pneumonia. If the patient has gram-negative rods, administer streptomycin.

Continue with Exercises

EXERCISES, LESSON 3

INSTRUCTIONS. Answer these exercises by writing the answer in the space provided. After you have answered all the exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers.

1. Fever and chills, facial and tooth pain, and a headache which is worse during the day are symptoms of _____.

2. Acute pharyngitis is sometimes a symptom of a specific disease such as measles, _____, whooping cough, or chickenpox.

3. Abnormal lymphocytes, lymph node disease, and hepatic dysfunction are symptoms of _____.

4. _____, an inflammation of the lining which covers the lungs and chest cavity, is usually a complication of some other respiratory condition such as pneumonia or tuberculosis.

5. Acute bronchitis can be caused by dust, chemical agents and/or _____ to pollens.

6. Three types of pneumonia are bacterial pneumonia,_____ pneumonia, and viral pneumonia.

7. When the patient breathes in airborne pollen, his nasal passages become inflamed. He is suffering from _____.

8. A patient with an increased white blood cell count, pain on swallowing, and strong breath odor could have strep throat or _____ .

9. A highly contagious disease caused by a virus whose strains include A, B, and C is _____.

10. Nasal congestion, profuse watery discharge, itching of nose and conjunctiva, and sneezing are all signs and symptoms of _____.

11. Paranasal sinusitis is _____

_____

12. There are over ninety distinct strains of _____ that can cause the common cold.

13. The most common causes of acute pharyngitis are bacterial infection and _____.

14. Septic sore throat and acute streptococcal pharyngitis are other names for the respiratory infection commonly called _____.

15. The respiratory disease which gets its name from the abnormal increase in single nucleus cells in the body is _____.

16. Influenza is a highly contagious disease which is caused by _____.

17. A person with pleuritis most likely has some other respiratory condition such as _____, _____, or another infectious disease.

18. Mild rales, nonproductive cough, and _____ are signs and symptoms of viral pneumonia.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES, LESSON 3

1. Paranasal sinusitis. (para 3-2b(1)(a)-(d))
2. Scarlet fever. (para 3-4a)
3. Mononucleosis. (para 3-6b)
4. Pleuritis. (para 3-9)
5. Allergies. (para 3-8a)
6. Mycoplasmal. (para 3-10a)
7. Allergic rhinitis. (para 3-1a)
8. Tonsillitis. (para 3-5b)
9. Influenza. (para 3-7a)
10. Allergic rhinitis. (para 3-1b)
11. Paranasal sinusitis is an infection of the mucous membranes which line the paranasal sinuses or the bony framework of the sinuses. (para 3-2a)
12. Rhinovirus. (para 3-3a)
13. Viral infection. (para 3-4a)
14. Strep throat. (para 3-5a(2))
15. Mononucleosis. (para 3-6a)
16. A virus. (para 3-7a)
17. Pneumonia, tuberculosis. (para 3-9a)
18. Mild illness. (para 3-14a)

End of Lesson 3

LESSON ASSIGNMENT

LESSON 4	Chronic Obstructive Pulmonary Diseases.
TEXT ASSIGNMENT	Paragraphs 4-1 through 4-10.
LESSON OBJECTIVES	After completing this lesson, you should be able to:
	4-1. Identify the characteristics, signs/symptoms, and treatment for asthma.
	4-2. Identify the characteristics, signs/symptoms, and treatment for chronic bronchitis.
	4-3. Identify the characteristics, signs/symptoms, and treatment for emphysema.
SUGGESTION	After completing the assignment, complete the exercises at the end of this lesson. These exercises will help you to achieve the lesson objectives.

CHRONIC OBSTRUCTIVE PULMONARY DISEASES

Section I. ASTHMA

4-1. DEFINITION/CHARACTERISTICS

a. Chronic obstructive pulmonary diseases (COPD) affect one out of five Americans. Asthma and bronchitis are common forms of COPD and are found more often in men than in women. The incidence of these diseases is more common among cigarette smokers than people who do not smoke. Asthma is a disease characterized by attacks of wheezing and difficult breathing. Spasms of the smooth muscles that lie in the walls of the smaller bronchi and bronchioles bring on the attacks and cause these passageways to close partially. Asthma can be caused by environmental factors such as dust or cold air. Asthma can also be caused by an infection, exercise, or emotional upset.

b. In an asthma attack, several bodily changes make it difficult for air to go through bronchi passageways. These changes include bronchoconstriction (bronchial muscles constricting), mucus secretion in the bronchi, and edema (fluid retention) in the bronchial wall. The difficulty in bringing air through those passages accounts for a sign almost always associated with asthma--wheezing.

c. There are five types of asthma. They are:

(1) Extrinsic (allergic) asthma.

(2) Intrinsic asthma.

(3) Triad asthma.

(4) Nasal polyp asthma.

(5) Bronchospasm.

4-2. SIGNS/SYMPTOMS

a. **Extrinsic (Allergic) Asthma.** This type of asthma usually affects children and young adults who have a personal or family history of being hypersensitive to substances in the environment, foods, or air substances that are inhaled. An individual can inherit an allergy to drugs, vaccines, and anesthetic agents also.

(1) Inhalant allergens include:

(a) Pollens.

(b) Dusts.

(c) Animal danders/hairs.

(d) Feathers.

(e) Molds.

(2) Food allergens include:

(a) Milk.

(b) Eggs.

(c) Nuts.

(d) Chocolate.

(e) Fish.

(f) Shellfish

(g) Strawberries.

(3) Irritant inhalants include:

(a) Fumes.

(b) Cold air.

(c) Air pollutants.

b. **Intrinsic Asthma.** This type of asthma is more common among adults over 35, especially women. Upper and lower respiratory tract infections may cause intrinsic asthma even though there has been no family or childhood history of the disease.

c. **Triad Asthma.** As the name implies, triad asthma includes three elements at the same time: aspirin (ASA), indomethacin (Indocin), and yellow food dye.

(1) Signs/symptoms of triad asthma include:

(a) Respiratory distress.

(b) Cough.

(c) Flushing--redness of skin.

(d) Cyanosis (bluish or grayish skin from oxygen poor blood).

(e) Apprehension.

(f) Tachycardia (rapid pulse).

(g) Perspiration.

(h) Flaring of nasal alae (outer side of each nostril).

(i) Dyspnea (labored or difficult breathing).

(j) Wheezing (quite audible or absent).

(2) The patient may have difficulty breathing and exhibiting these signs of respiratory distress:

(a) Dyspnea.

(b) Wheezing.

(c) Hyperresonance (very loud body sounds).

(d) Rhonchi.

(e) Wheezing in a particular part of the body indicating an obstruction by a foreign body or a tumor in the area. If a patient is wheezing, it is not safe to say that the patient has asthma. Not every person who wheezes has asthma. Wheezing may also be caused by:

1 Acute left heart failure (cardiac asthma).

2 Smoke inhalation.

3 Chronic bronchitis.

4 Acute pulmonary embolism.

4-3. LABORATORY FINDINGS

a. Chest x-rays usually show nothing abnormal.

b. If the patient shows signs of wheezing and dyspnea, chest x-rays and other laboratory tests are used to rule out the following:

(1) Pneumothorax (an accumulation of air or gas in the pleural space).

(2) Mucus plugging (a glob of mucus obstructing passageways).

(3) Pneumonia.

(4) Foreign body obstructing passageways.

(5) Cancer.

4-4. TREATMENT

a. **Purpose.** The purpose of treatment in an asthma attack is twofold. First, it is necessary to treat the symptoms of the attack. Then, causes of the attack should be diagnosed and treatment begun to prevent further attacks.

b. **Hospitalization**. Consider hospitalization when the patient has had one or more of the following situations:

(1) Seventy-two hours of unremitting asthma.

(2) One hour of adequate acute therapy without improvement.

(3) Three trips to the emergency room in three days.

(4) Quiet chest.

(5) Pulsus paradox (an abnormal decrease in systolic pressure during inspiration, the decrease being greater than 10 mm of mercury [Hg]).

(6) Sternocleidomastoid muscle and intercostal muscle withdrawing.

(7) Low carbon dioxide pressure (PCO_2).

c. **Monitoring**. During treatment for an acute asthma attack, monitor arterial blood gases every 30 to 60 minutes.

d. **Long-Term Therapy.** Long-term therapy is an attempt to identify the cause of asthma attacks and prevent those causes. Long-term therapy includes:

(1) Discovering and avoiding, if possible, whatever causes the asthma attack.

(2) Being desensitized against whatever is causing the asthma; for example, desensitization against ragweed, other pollens, etc.

(3) Taking appropriate medication. (Tedral, Quibron, aminophylline, and steroids are drugs that can be used to treat asthma).

e. **Asthma in Children.** The treatment for asthma in children requires providing a pleasant and understanding home environment. Over-protection or parental resentment must be avoided.

f. **Acute Asthma Attack.** An acute attack of asthma is treated as a respiratory emergency. First, determine what medications the patient has taken within the last 12 hours.

(1) Procedure for an adult patient is given below.

(a) Open the airway if it is not open.

(b) Give humidified oxygen or a nebulizer (a device for throwing a spray). Use an intermittent positive pressure breathing (PPB) device if one is available. Do not use the unmodified demand valve on the PPB device because the dry gases it will send to the airway makes the mucus secretions worse.

(c) Establish an IV with a solution of five percent water with dextrose (D5W) or D5/normal saline.

(d) Administer epinephrine 1:1000, 0.3 to 0.5 ml subcutaneously (adult dose) if the patient has not taken large doses of inhalant bronchodilators. Repeat the dose in thirty minutes, if necessary.

(e) Aminophylline may be given by adding 250 mg of the drug to a 250 ml bag of D5/W. This infusion can be attached to the IV in piggyback fashion.

(f) Bronchodilators such as epinephrine (Isoproterenol, Isuprel) or Isoetharine (Bronkosol) may be administered by aerosol.

WARNINGS

DO NOT give sedatives that may depress respiration or antihistamines that dry secretions.

DO NOT give aspirin. Many asthmatics are allergic to aspirin.

(2) Procedure for a child is given below.

(a) Give oxygen.

(b) The drug of choice is epinephrine, 1:1000 0.01 ml/kg to 0.3 ml is the maximum dosage. The dosage may be repeated once or twice every 20 minutes. Alternative drugs that may be used include the following:

1 Sus-Phrine (1:200 aqueous suspension of epinephrine).

2 Theophylline preparation administered in a 4 mg/kg of body weight IV in 25 cc D5W over 5-15 minutes not exceeding 25 mg per minute. IV hydration is important (D5W or D5-saline wide open).

(c) Avoid using sedatives and oral preparations when treating asthma in an emergency situation.

(d) Aminophylline suppositories are a possible treatment.

CAUTION: Administering epinephrine after the use of over the counter (OTC) bronchodilators can cause severe circulatory disease or cardiac arrhythmias.

(3) In the case of a prolonged asthma attack, consider that the cause might be an infection or an allergen.

(4) Status asthmaticus is a condition that is considered a medical emergency. Status asthmaticus is a severe prolonged asthmatic attack that cannot be broken with epinephrine.

(a) Signs/symptoms include the following:

1 Chest that is severely distended.

2 Severe dyspnea (difficult or labored breathing).

3 Prominent use of accessory muscles.

4 Breath sounds (wheezes may be entirely inaudible).

5 Exhaustion.

6 Severe acidosis (accumulation of acid or depletion of the alkaline reserve in the blood and body tissues).

7 Dehydration.

(b) Other signs/symptoms may be:

1 Hypoxia (lack of oxygen reaching body tissues) contributing to encephalopathy (disease of the brain or spinal cord).

2 Respiratory acidosis.

3 Pneumomediastinum (presence of air or gas in the mediastinum which may interfere with respiration and circulation).

4 Possible progressive respiratory tract impairment.

(c) Treatment. Treatment is similar to that for acute asthma and includes the following:

1 Give oxygen by intermittent positive pressure breathing (IPPB). A machine delivering IPPB forces oxygen into the patient as the patient starts to take a breath. The machine automatically forces enough oxygen into the patient's lungs to open the alveoli.

2 Administer sodium bicarbonate intravenously to counteract acidosis. If you must add the medication to the primary intravenous bottle, use strict aseptic technique and follow this basic procedure:

a Wash your hands.

b Check the medication order.

c Prepare the medication and draw it up in a syringe.

d Remove the metal protector and rubber diaphragm from the bottle.

e Insert the needle into the injection site.

f Mix the solution and medication.

g Label the bottle.

h Discard the used needle and syringe.

i Record the medication.

3 Reassure the patient.

4 Transport the patient to a hospital immediately.

5 Begin an intravenous infusion (IV) lifeline of dextrose in water solution (D5W).

Section II. CHRONIC BRONCHITIS

4-5. DEFINITION/CHARACTERISTICS

Chronic bronchitis is an inflammation of the bronchi of long duration. There is a productive cough associated with recurring infections of the lower respiratory tract. The result is a reduced ability to ventilate (breathe in and out) the lungs. A characteristic is an excessive, recurrent, mucus-producing cough. The patient is usually a heavy cigarette smoker who is obese. The soft tissues around the patient's fingers and toes may have undergone changes, but not the bone structure.

4-6. SIGNS/SYMPTOMS

As the disease becomes more severe, the following signs/symptoms may be noticed in the patient.

a. Rales (a dry or moist sound according to the absence or presence of fluids in the air passages).

b. Rhonchi (a dry, coarse sound in the bronchial tubes due to a partial obstruction).

c. Wheeze (a whistling sound made in breathing).

d. Light fever (101ºF to 102ºF).

e. Back and muscle pain.

f. Cyanosis (blue bloater; a bluish discoloration of the skin and/or membranes; in dark-skinned individuals, the skin discolors to gray or grayish tone).

g. More purulent (containing pus) and increase in volume of mucus produced with a cough.

h. Patient weakening due to hypoxia (lack of adequate oxygen).

i. Confusion due to hypoxia.

j. Muscle twitching.

k. Edema (abnormal accumulation of fluid in body tissues).

l. Jugular vein distention.

m. Barrel chest, perhaps.

n. Productive cough with sputum color changes.

4-7. TREATMENT

Keep in mind that the patient may be suffering from another disease, and bronchitis is a secondary problem. Remember the following:

a. The patient should avoid possible irritants such as smoking, allergenic agents, fumes and/or other irritants.

b. Codeine phosphate or a comparable antitussive agent can be used to suppress a nonproductive cough.

c. Mist inhalations (cool or warmed) and adequate fluid intake can be used to cope with thick sputum.

d. A drug such as terbutaline can be used to relieve bronchial spasm (violent cough).

e. Antihistamine drugs may reduce bronchial inflammation due to allergy.

f. Other measures may be taken depending on the cause of the bronchitis.

Section III. EMPHYSEMA

4-8. DEFINITION/CHARACTERISTICS

The word emphysema means "blown up" or "full of air." In emphysema, the alveolar walls of the lungs have lost their elasticity, causing air to remain trapped in the lungs when the person breathes out. A first symptom is that the person exhales less than his usual amount of air. Alveoli in other areas of the lungs become damaged later. Many alveoli may unite, thus further reducing the overall volume of air the person is able to inhale.

a. Eventually, the lungs become permanently inflated because they have lost their elasticity. The size of a person's chest increases to adjust to the new larger size of the permanently inflated lungs. At this point, the person has to work voluntarily to exhale. The oxygen in the blood is a little lowered, and the person becomes breathless from any mild exercise in which the blood cells need more oxygen. As the disease progresses, unusually high amounts of carbon dioxide dissolve in the plasma producing acid conditions that are toxic to brain cells. This causes the body's inspiration area to become less active which causes the respiration rate to slow down.

b. A number of factors can cause emphysema.

(1) A tendency in some families for chronic obstructive pulmonary diseases such as silicosis (a disease caused by inhaling stone, sand, or flint dust into the lungs) or fibrosis (formation of fibers in the lungs).

(2) A history of chronic bronchial obstruction such as bronchitis or asthma.

(3) Cigarette smoking is thought to be a major cause.

(4) The result of a penetrating wound of the chest wall.

4-9. SIGNS/SYMPTOMS

a. The signs and symptoms of emphysema are listed as follows:

(1) Shortness of breath.

(2) Pursed lip breathing (pink puffers).

(3) Barrel chest appearance.

(4) Wheezing.

(5) Chronic cough.

(6) Expectoration with small quantities of mucus.

(7) Dyspnea (difficult or labored breathing) on exertion.

(8) Hyperresonant to percussion.

(9) Appears thin and wasted (weight loss).

(10) Difficulty in hearing sounds in body while listening to lungs with stethoscope.

b. In all cases of chronic cough, asthma, or any disease that produces pulmonary fibrosis, a diagnosis of emphysema should be considered. Early diagnosis is difficult, but advanced cases of emphysema are evident by the following symptoms:

(1) Severe dyspnea (difficult or labored breathing).

(2) Distended chest.

(3) Depressed diaphragm.

(4) Abnormal blood gases.

4-10. TREATMENT

Treatment for emphysema is designed to correct or diminish the causes. For example, if air pollution, occupational exposure to industrial dust, or cigarette smoke is causing the problem, the patient must remove himself from these air pollutants as much as possible. Mist inhalations and supplemental fluids can be used to thin secretions that are thick. Other treatments designed to combat the cause of the condition can be used. Bed rest is not the main treatment but can be given when necessary.

Continue with Exercises

EXERCISES, LESSON 4

INSTRUCTIONS. Answer these exercises by writing the answer in the space provided or choosing the statement that best answers the question. After you have answered all the exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers.

1. Asthma and bronchitis are common forms of _____

   _____

2. Asthma is a disease in which muscle spasms in the walls of the small bronchi and bronchioles bring on the attack and cause _____

   _____ .

3. List the five types of asthma.

   a. _____.

   b. _____.

   c. _____.

   d. _____.

   e. _____.

4. List three inhalant allergens given in this lesson to which a person could be allergic.

   a. _____.

   b. _____.

   c. _____.

5. List four food allergens mentioned in the lesson that might cause an asthma attack.

   a. _____.

   b. _____.

   c. _____.

   d. _____.

6. List three irritant inhalants mentioned in the lesson.

   a. _____.

   b. _____.

   c. _____.

7. _____ asthma is more common among adults over 35, especially women.

8. List four signs/symptoms of triad asthma.

   a. _____.

   b. _____.

   c. _____.

   d. _____.

9. Wheezing in a particular part of the body indicates _____

   _____

10. List two situations in which you may hospitalize a patient with asthma.

    a. _____.

    b. _____.

11. The purpose of long term asthma therapy is _____

    _____

12. Which response is **NOT** part of the treatment for an adult having an acute asthma attack?

    a. Open the airway.

    b. Give humidifier oxygen or a nebulizer.

    c. Give a sedative to relax the patient.

    d. Establish an IV with D5W or D5 normal saline.

    e. Use a bronchodilator such as epinephrine.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES, LESSON 4

1. Chronic obstructive pulmonary diseases. (para 4-1a)

2. These passageways to close partially. (para 4-1a)

3. Extrinsic (allergic)asthma.
   Intrinsic asthma.
   Triad asthma.
   Nasal polyp asthma.
   Bronchospasm. (para 4-1c)

4. You are correct if your listed any three of the following:

   Pollens.
   Dusts.
   Animal danders.
   Feathers.
   Molds. (para 4-2a(1))

5. You are correct if you listed any four of the following:

   Milk.
   Eggs.
   Nuts.
   Chocolate.
   Fish.
   Shellfish.
   Strawberries. (para 4-2a(2))

6. Fumes.
   Cold air.
   Air pollutants. (para 4-2a(3))

7. Intrinsic. (para 4-2b)

8. You are correct if you listed any four of the following:

   Respiratory distress.
   Cough.
   Floushing.
   Cyanosis.
   Apprehension.
   Tachycardia.
   Perspiration.
   Flaring of nasal alae.
   Dyspnea.
   Patient sitting up.
   Wheezing. (paras 4-2c(1)(a)-(j))

9. An obstruction by a foreign body or a tumor in the area. (para 4-2c(2)(e))

10. You are correct if you listed any two of the following:

    Seventy-two hours of unremitting asthma.
    One hour of adequate acute therapy without improvement.
    Three trips to the emergency room in three days.
    Quiet chest.
    Pulse rate which varies more than 10mm Hg.
    Sternocleidomastoid muscle and intercostal muscle withdrawing.
    Low carbon dioxide pressure (PCO_2). (paras 4-4b(1)-(7))

11. To identify the cause of and prevent asthma attacks. (para 4-4d)

12. c. (paras 4-4f(1)(a)-(f))

End of Lesson 4

LESSON ASSIGNMENT

LESSON 5	Respiratory Disorders.
TEXT ASSIGNMENT	Paragraphs 5-1 through 5-17.
LESSON OBJECTIVES	After completing this lesson, you should be able to:

5-1. Identify the characteristics, signs/symptoms, and treatment for hyperventilation syndrome.

5-2. Identify the characteristics, signs/symptoms, and treatment for spontaneous pneumothorax.

5-3. Identify the characteristics, signs/symptoms, and treatment for pulmonary embolism.

5-4. Identify the characteristics, signs/symptoms, and treatment for inhaled toxic substances.

SUGGESTION After completing the assignment, complete the exercises at the end of this lesson. These exercises will help you to achieve the lesson objectives.

LESSON 5

RESPIRATORY DISORDERS

Section I. HYPERVENTILATION SYNDROME

5-1. DEFINITION/CHARACTERISTICS

a. **Hyperventilation.** Hyperventilation, a common response to psychological stress, is a condition that develops as a result of an individual breathing too deeply and too rapidly. Blood pH (hydrogen ion) is raised above normal, and the body experiences alkalosis (a condition in which the blood pH is between 7.45 and 8.00). By breathing as rapidly as possible for three to five minutes, a person can bring on the signs and symptoms of hyperventilation deliberately.

b. **Hyperventilation Syndrome.** Patients who are anxious and often feel fatigue, nervousness, and dizziness may suffer from hyperventilation syndrome. The individual may breathe rapidly, breathing out so much carbon dioxide that he becomes unconscious. Unconscious, he begins to breath normally again, the carbon dioxide level becomes normal, and he regains consciousness. When the patient becomes nervous and anxious again, he is likely to experience hyperventilation syndrome again.

5-2. SIGNS/SYMPTOMS

The following signs/symptoms are characteristic of a hyperventilation syndrome attack:

a. Nervousness.

b. Tachypnea (excessively high rate of breathing [for adults, over 25 respirations per minute]).

c. "Unable to catch breath."

d. Dizziness.

e. Tingling or numbness around mouth or in hands and feet.

f. Carpopedal spasm (spasm of muscles in the carpus [the joint between the hand and the wrist] and/or spasm of muscles in the foot).

5-3. TREATMENT

Calm the patient and have him breathe into a paper bag. This will cause the patient to breathe his own exhaled breath (which is high in carbon dioxide). In that process, the patient will raise the carbon dioxide level in his body. This act is considered a controversial treatment for hyperventilation syndrome because the syndrome could have been brought on by another underlying condition such as diabetic ketoacidosis. The treatment is effective however, and should be considered carefully making sure that no underlying condition exists prior to using it.

Section II. SPONTANEOUS PNEUMOTHORAX

5-4. DEFINITION/CHARACTERICS

a. In spontaneous pneumothorax, a weak area in the surface of the lungs will rupture for no apparent reason, allowing air to leak into the chest cavity. The affected lung collapses and loses its ability to expand normally. There are all degrees of this condition, from the patient who is not particularly uncomfortable to the patient who suffers respiratory distress and must be taken to the hospital.

b. Other causes of pneumothorax include the following.

(1) Perforation of the pleura by erosion through the diaphragm.

(2) An abscess or emphysema during the course of a pulmonary disease, such as tuberculosis.

(3) Rupture of a bleb (a large weak vessel).

(4) Coughing.

(5) Exertion.

(6) Rapid altitude changes; for example, a parachute drop.

(7) Diving.

5-5. SIGNS/SYMPTOMS

Signs and symptoms include the following:

a. Dry, hacking cough.

b. Sudden sharp chest pain or vague chest discomfort.

c. Dyspnea (labored or difficult breathing).

d. Pain in shoulder and arm.

e. In tension pneumothorax, the percussion note is hyperresonant (louder) over the involved side.

f. Diminished motion on the affected side.

5-6. DIAGNOSIS

A chest x-ray may be used to confirm the diagnosis of pneumothorax. A film taken when the patient exhales will show air in the pleural space with a visible border of retracted lung. The lung may have retracted in one area only.

5-7. TREATMENT

a. **Small Pneumothorax.** No special treatment is required as the air is reabsorbed in a few days.

b. **Bilateral Pneumothorax.** Introduce a chest tube with water-sealed drainage. Suction the air out of the chest cavity so that the lung can expand rapidly.

c. **Tension Pneumothorax.** Insert a short, beveled needle or a chest tube into the front part of the affected area of the chest and drain the air or fluid from the chest cavity.

Section III. PULMONARY EMBOLISM

5-8. DEFINITION/CHARACTERISTICS

Pulmonary embolism is defined as the sudden blocking of a pulmonary artery or one of its branches by a blood clot or other obstruction. The obstruction is carried to the site by the blood current. For example, blood clots may form in the veins of the legs or pelvis and be carried through the veins, through the right heart, where they reach the narrowing network of pulmonary vessels. Factors that favor the development of such obstructions include the following.

a. **Prolonged Immobilization.** Blood becomes stagnant in the lower extremities of bedridden patients, and blood clots can form. A lower extremity in a cast is also conducive to blood clot formation.

b. **Thrombophlebitis (Inflammation of the Veins).** A patient suffering from thrombophlebitis in the pelvis or legs may have blood clots form in either of those area.

c. **Drugs.** An individual taking certain drugs (for example, birth control pills) has a higher risk of developing blood clots.

d. **Fat Particles.** Other substances in addition to blood clots may cause an obstruction in an artery. Particles of fat may break loose during a severe injury to the body, be carried by the bloodstream, and lodge in an artery.

e. **Amniotic Fluid.** During childbirth, amniotic fluid may enter the mother's circulatory system and move into the mother's lungs.

5-9. SIGNS/SYMPTOMS

The signs and symptoms of pulmonary embolism vary with the size of the obstruction. The typical patient may have a sudden onset of severe, unexplained dyspnea (sharp chest pain made worse by coughing or deep breathing), tachycardia (rapid heart rate, over 100 beats per minute), labored breathing, and falling blood pressure. A chest examination may show no abnormalities, however.

5-10. DIAGNOSIS/PHYSICAL EXAMINATION

a. **Perform an Auscultation Examination.** Listen for atelectatic rales (fine, rattling sounds in a lung which is not completely expanded). Also, listen for localized wheezes (high-pitched notes like musical sounds).

b. **Take the Pulse.** The pulse rate may be over 100 beats per minute (tachycardia).

NOTE: A deep tenderness in the calf area of the leg may indicate phlebitis.

5-11. TREATMENT

a. **In the Field.** Treatment is largely supportive since definitive therapy with anticoagulants requires hospitalization. Follow this procedure:

(1) Ensure an open airway.

(2) Assist ventilations as needed.

(3) Administer oxygen in the highest possible concentration.

(4) Establish an IV lifeline with a solution of water with five percent dextrose (D5W) and monitor the patient's cardiac rhythm.

b. **In the Hospital.** Treatment in the hospital includes these procedures:

(1) Bed rest.

(2) Analgesics to relieve pain, perhaps a narcotic.

(3) Oxygen.

(4) Intravenous (IV) therapy.

(5) Treatment for shock, if present.

(6) Warm packs for thrombophlebitis (inflammation of a vein).

(7) Anticoagulation medication such as heparin or Coumadin.

(8) Surgical ligation (tying or binding the vein) or embolectomy (surgical removal of the blood clot).

5-12. PREVENTION OF VENOUS STASIS

Increased pressure on veins causes the veins to become abnormally dilated; this condition is referred to as venous stasis. Such veins are most commonly seen in the superficial veins of the legs. Elastic hose and leg exercises help prevent venous stasis. In severe cases, amputation may be necessary.

Section IV. INHALED TOXIC SUBSTANCES

5-13. DEFINITION/CHARACTERISTICS

Inhaled toxic substances refer to combustion and chemical irritants that a person breathes in, thus damaging parts of his body. Damage may be caused by such things as a blast of hot, wet air (steam), or poisonous gas. The damage done to the body may be obstruction due to edema in the airway and alveoli, a bronchospasm attack, or chemical pulmonary edema.

5-14. TOXIC AGENTS (INHALANTS)

Gases that combine with water to form corrosive acids or alkali fumes that cause burns to the upper respiratory tract are toxic agents. Other toxic agents include:

a. Ammonia and ammonium hydroxide.

b. Nitrogen oxide and nitric oxide.

c. Sulfur dioxide and sulfurous acid.

d. Decomposed chlorinated hydrocarbons.

e. Chlorine gas (found in swimming pools).

5-15. PATIENT HISTORY/PHYSICAL EXAMINATION

a. **Patient History**. When taking patient history, be sure to include the following specific information.

(1) The duration of exposure to the toxic inhalant.

(2) Whether the patient was in a closed or open environment during exposure. A person in a closed environment is more liable to have respiratory tract damage. Inhaling of a substance in the open, however, can cause similar damage to the respiratory tract.

(3) Whether the patient lost consciousness. If the patient lost consciousness, mechanisms that usually protect the lower respiratory tract may not have functioned.

(4) Identity of the toxic agent(s), if possible.

b. **Physical Examination**. The physical examination of the patient suffering from inhalation of toxic substances should include inspection of the mouth and face, visual examination of the throat, and auscultation of the chest.

5-16. COMMON SIGNS/SYMPTOMS

A person who has inhaled something toxic will commonly experience irritation to the eyes, sneezing, coughing, dyspnea (labored or difficult breathing), and/or choking.

5-17. TREATMENT

a. First, establish and maintain an airway.

CAUTION: If laryngeal edema develops rapidly, you may need to perform an endotracheal intubation or cricothyrotomy in the field.

b. Assist ventilation as needed.

c. Administer humidified oxygen in the highest concentration available to all toxic inhalant patients, whether they seem to need oxygen or not.

d. Establish an IV lifeline with a solution of water with five percent dextrose.

e. Monitor cardiac rhythm and general status of patients who have suffered intense exposure to smoke or toxic fumes. Continue monitoring for 18 to 24 hours.

f. Refer to table 5-1 for signs/symptoms and treatments for ammonia gas, nitrogen oxide, sulfur oxide (SMDG), and cholorinated hydrocarbons-petroleum distillates.

SIGNS/SYMPTOMS	TREATMENT
A. Ammonia gas	
1. Irritation of eyes and respiratory tract. 2. Cough. 3. Choking. 4. Abdominal pain.	1. Flush eyes with tap water for 15 minutes. 2. Give severe positive pressure oxygen to prevent pulmonary edema. 3. Support respirations.
B. Nitrogen Oxide	
1. Local burning in eyes, nasal pharyngeal, or mucous membranes. 2. Fatigue. 3. Cough. 4. Dyspnea. 5. Pulmonary edema. 6. Later, bronchitis, pneumonia.	1. Absolute bed rest. 2. Pure oxygen as soon as symptoms develop. 3. For excessive pulmonary foam, suction. 4. Postural drainage.
C. Sulfur Oxide (SMDG)	
1. Respiratory tract irritation. 2. Sneezing. 3. Cough. 4. Dyspnea. 5. Pulmonary edema.	1. Remove from contaminated area. 2. Give oxygen positive pressure breathing. 3. Respiratory support.
D. Chlorinated Hydrocarbons--Petroleum Distillates	
1. Euphoria. 2. Burning in chest. 3. Headache. 4. Weakness. 5. CNS depression. 6. Confusion.	1. Oxygen. 2. Support respirations.

Table 5-1. Toxic inhalants.

Continue with Exercises

EXERCISES, LESSON 5

INSTRUCTIONS. Answer these exercises by writing the answer in the space provided. After you have answered all the exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers.

1. An individual who breathes too deeply and too rapidly can bring on a condition called _____.

2. Sometimes a weak area in the surface of the lungs will rupture allowing air to leak into the chest cavity; the resulting condition is called _____.

3. A chest x-ray showing air in the pleural space with a visible border of retracted lung when the patient exhales is an indication that he suffers from _____.

4. List three causes of pulmonary embolism.

   a. _____.

   b. _____.

   c. _____.

5. A person having a deep tenderness in the calf area of the leg may be suffering from _____.

6. List three signs/symptoms of hyperventilation.

   a. _____.

   b. _____.

   c. _____.

7. A person suffering from _____ should breathe into a paper bag.

8. List three types of spontaneous pneumothorax are:

   a. _____.

   b. _____.

   c. _____.

9. The patient has inhaled a toxic substance. List four items of information that should be included when taking this patient's history.

   a. _____.

   b. _____.

   c. _____.

   d. _____.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES, LESSON 5

1. Hyperventilation. (para 5-1a)

2. Spontaneous pneumothorax. (para 5-4a)

3. Pneumothorax. (para 5-6)

4. You are correct if you listed any three of the following:

   Prolonged immobilization.
   Inflammation of the veins.
   Drugs.
   Fat particles.
   Amniotic fluid. (para 5-8a through e)

5. Plebitis. (para 5-10 NOTE)

6. You are correct if you listed any three of the following:

   Nervousness.
   Tachypnea.
   Unable to catch breath.
   Dizziness.
   Tingling or numbness around mouth or in hands and feet.
   Carpopedal spasm. (para 5-2a-f)

7. Hyperventilation. (para 5-3)

8. Small pneumothorax.
   Bilateral pneumothorax.
   Tension pneumothorax. (paras 5-7a, b, c)

9. Duration of exposure to toxic agents.
   Whether the patient was in an open or closed environment.
   Whether the patient lost consciousness.
   Identity of toxic agents. (paras 5-15a(1)-(4))

End of Lesson 5

LESSON ASSIGNMENT

LESSON 6	Tuberculosis.
TEXT ASSIGNMENT	Paragraphs 6-1 through 6-11.
LESSON OBJECTIVES	After completing this lesson, you should be able to:
	6-1. Identify the characteristics, signs/ symptoms, diagnosis, and treatment for tuberculosis.
	6-2. Identify the reservoir, sources, and transmission of tuberculosis infection.
	6-3. Identify the measures in the tuberculosis control program.
SUGGESTION	After completing the assignment, complete the exercises at the end of this lesson. These exercises will help you to achieve the lesson objectives.

LESSON 6

TUBERCULOSIS

6-1. DEFINITION

Tuberculosis is a chronic disease caused by the bacteria Mycobacterium tuberculosis. The initial disease may not be noticed, but eventually the infection may spread to various parts of the body (for example: tuberculosis of the bones and joints, intestinal tuberculosis, and urinary tract tuberculosis). The incidence of tuberculosis is less today than in the past. In the United States Army in World War II, the number of tuberculosis cases was 1 per 1,000 soldiers. By 1982, only 250,000 cases were reported in the United States. The decline in the number of cases can be attributed to three factors: education about causes of tuberculosis; better diet and nutritional information; and early diagnosis and treatment of tuberculosis cases.

6-2. COMMUNICABILITY OF INFECTION

a. **Reservoir, Sources, Transmission Route.** The most common reservoir of tuberculosis is man. The source of infection is respiratory secretion of individuals who have active pulmonary lesions. Tuberculous bacteria may be transmitted by direct or indirect contact with the patient who has open lesions. The most common route of transmission, however, is by inhaling airborne droplet nuclei. When a patient coughs or sneezes, a person may inhale the bacteria in the air and, if susceptible, may contract tuberculosis. Family, military, and institutional living can contribute to the spread of tuberculosis if a person has an active case that is unrecognized and, consequently, untreated. A reservoir for Mycobacterium bovis, the bovine strain of tuberculosis, is diseased cattle. Man ingests this bacillus by drinking the raw milk from such cattle. Man may also contract this type of tuberculosis by inhaling airborne organisms in and around barns that have infected animals or by handling infectious animal products. Since herds of animals are continuously tested for tuberculosis and milk is pasteurized, this form of tuberculosis has been controlled.

b. **Incubation Period.** The incubation period is usually about four to six weeks from the time of effective exposure to the appearance of a primary lesion of first infection. The time between the first infection and reinfection of tuberculosis may be many years. If the individual is reinfected, the length of time necessary for new lesions to develop depends on the general health of the person and the source and numbers of organisms entering his system.

c. **Communicability.** A patient is infectious for as long as he discharges tubercle bacilli. The degree of communicability depends on several factors: density of contaminated droplets in the air; coughing habits of the patient; and air circulation and fallout in the particular environment. During the period when the patient is infectious, an uninfected person needs to inhale at least one infectious droplet nucleus to become infected. The healthy person must inhale tubercle bacilli so that they are carried far down the airways to a point in the lung where fixed mononuclear phagocytes can pick the droplets up and droplet intracellular multiplication can begin. The infected patient's sputum, if it carries enough bacilli, is a source of infection when the patient coughs or sneezes thus spraying the air with bacilli. If there are several people living close together, just one of them being infected with tuberculous bacilli can spread the disease to the others.

d. **Immunity.** How susceptible people are to infection in general is influenced by several factors: age, sex, race, nutrition, and general health. In regard to tuberculosis, children under 3 years old are the most susceptible. There have been fewer cases of tuberculosis in children since bovine tuberculosis has been controlled. (Children are no longer consuming infected dairy products.) There are fewer cases of tuberculosis among Caucasians than among Blacks and American Indians, but no one is sure of the reason. Perhaps through the years only Caucasians most resistant to tuberculosis have survived. In general, possibly Caucasians live in better environments and eat more nutritionally balanced meals thus giving them better health. The number of cases of tuberculosis is usually greater among city dwellers than among those who live in the country. City people live closer together; therefore, one infected city dweller will probably come in contact with and pass on the tuberculosis infection to more people than a country dweller.

6-3. SIGNS/SYMPTOMS

From the time of infection, it takes about four to eight weeks for a person to develop tuberculosis. The person may have no symptoms, mild symptoms, or nonspecific symptoms. If there are symptoms, these are the most common:

a. Fatigue.

b. Anorexia.

c. Weight loss.

d. Irregular menses.

e. Low grade fever.

f. Night sweats.

g. Cough (which has no specific characteristics).

h. Hemoptysis (blood in the sputum).

i. Pleuritic chest pain (pain in the pleural chest cavity).

6-4. TYPES OF TESTS

a. **Chest X-ray**. In almost all cases, a chest x-ray will show the disease. A single chest x-ray is not usually enough to diagnose tuberculosis. This is because tuberculosis lesions behind ribs, cardiovascular structures, and the diaphragm will not show up on a chest x-ray for tuberculosis. Several chest x-rays, therefore, are needed to establish the activity of the bacilli and to select and determine the appropriate treatment.

b. **Tuberculin Skin Testing**. The basis of tuberculin skin tests is that the skin is hypersensitive to a specific bacterial protein antigen. Administer the antigen and examine the induration (hardening of the area on which the antigen was placed). A positive reaction (induration 10 mm or more in diameter) indicates only exposure to tuberculosis; it does not necessarily mean that the person has tuberculosis. To find out whether the person has tuberculosis now, use x-ray or bacteriological methods. People who have a negative tuberculin reaction include the following: those who have never been infected; those who are in the preallergic early stage of first infection, and, strangely enough, those with advanced terminal tuberculosis.

(1) Tine test. The tine test uses dried, old tuberculin (OT) on multiple metal tines (sharp, pointed prongs like a fork) which are in a round, plastic head. When the tines are pressed against an individual's skin, the antigen is forced between layers of the skin in the same manner as an injection. This method of testing is safe and convenient for mass surveys. The site where the test was done should be read between 48 and 72 hours after the test was performed. What the site looks like determines whether the test resulted in a positive take, a doubtful take, or a negative take as noted below:

(a) Positive take--induration but no erythema (abnormal) skin redness.

(b) Doubtful take--2 mm induration.

(c) Negative take--less than 2 mm induration.

(2) Mantoux test. This test, used for adult testing, must be used if the tine test is doubtful or positive. The test requires intradermal injection of antigen 0.1 ml (1 I.U.) of purified protein derivative (PPD). If a fairly high level of susceptibility is expected, 0.1 ml (0.5 I.U.) of PPD may be used. Read from 48 to 72 hours. Note the following information:

(a) Positive take--10 mm induration or more.

(b) Doubtful take--5 mm through 9 mm induration.

(c) Negative take--less than 5 mm induration.

(3) Conversion. Conversion refers to a positive reaction that has occurred within one year after a known negative reaction. If the person tested is under 35 years old, begin treatment for tuberculosis immediately.

6-5. GENERAL CARE

How rapidly and/or how well tuberculosis lesions heal depends on two factors: specific drug treatment and the body's defense mechanism. Bed rest is necessary only if the patient has a fever, hemoptysis (blood-stained sputum), or a severe cough. A patient with any of these symptoms may need a few weeks of bed rest. The patient whose sputum contains tuberculosis bacilli should be isolated until effective treatment has been given for at least two weeks. Generally, these and other patients whose drug treatment has been established can return to normal physical activity.

6-6. DRUG THERAPY

Drug treatment must continue for at least eighteen to twenty-four months. A minimum of two drugs should be used concurrently, but there is a strong trend toward the use of three drugs. Drug therapy appears to be most effective when taken in a simple daily dose on an empty stomach.

a. **Isoniazid.**

(1) Drug use. Isoniazid (INH) should always be included in the original treatmentand always used in conjunction with other anti-tuberculosis drugs. The dosage for adults is 5 mg/kg per day up to 300 mg per day. This is the most effective drug at the present time; however, there may be adverse reactions.

(2) Adverse reactions. If the dosage is the usual 5 mg/kg daily, adverse reactions to isoniazid are unusual. Cases of hepatitis thought to have been caused by the drug have been reported. If the patient has a liver dysfunction, be cautious in prescribing the drug. Tell patients to be sure to stop taking the drug and notify the doctor if any adverse signs/symptoms occur. A patient taking large doses of isoniazid may experience peripheral neuropathy (disturbances in the peripheral nervous system) and, occasionally, central nervous system irritability caused by depletion of pyridoxine, one of the forms of vitamin B6. Urine retention is another possible adverse reaction from isoniazid.

b. **Rifampin (Rifadin®).** This drug, a semisynthetic derivative of rifamycin, is given orally and usually well tolerated. The drug distributes readily into all body tissue fluids including the cerebral spinal fluid (CSF). The dosage is 600 mg (two 300 mg caps). Rifampin must be used along with another anti-tuberculosis drug. Adverse reactions include anorexia, diarrhea, and headache.

c. **Streptomycin.**

(1) Drug use. Streptomycin, less effective than isoniazid in advanced tuberculosis cases, must be given in conjunction with other drugs. The dosage is 1 to 2 mg daily by intramuscular injection.

(2) Adverse reactions. If streptomycin is used daily, the drug may cause eighth nerve damage (vertigo, deafness). If the drug is continued, the damage may be irreversible. Occasionally, the patient suffers generalized dermatitis (inflammation of the skin) in which case use of the drug must be discontinued.

d. **Ethambutol (Myambutol®).**

(1) Drug use. Ethambutol, the principal second line drug, must be used in combination with another drug, normally isoniazid. Ethambutol will prevent the development of organisms which are resistant to major drugs. The dosage is 15 mg/kg, given orally.

(2) Adverse effects. This drug has few side effects. Optic neuritis (inflammation of the optic nerve) is one possible side effect, but it is usually minor and reversible. Before and during treatment with this drug, the patient's clarity of vision should be checked. If vision becomes less clear, the use of this drug should be discontinued. Since clearness of vision cannot be properly checked in infants and young children, avoid using ethambutol with these patients.

e. **Bacille Calmette-Guerin Vaccine.** Bacille Calmette-Guerin (BCG) vaccine, administered intradermally, is a living, attenuated strain of tubercle bacilli of bovine origin. The vaccine offers no positive protection to tuberculin-negative people but can give false-positive readings. The vaccine converts at least 90 percent of tuberculin-negative people to a state of skin sensitivity. The protection given by vaccination is only partial, and no one is quite sure how long the vaccination lasts. Mass vaccination with this vaccine is applicable only in situations where risk of infection and the number of tuberculin-negative contacts of active disease are both high.

(1) Drug use. The dosage is 50 mg per day by mouth. Use pyridoxine (B6) only if the patient experiences side effects when taking isoniazid. This drug is not used routinely.

(2) Adverse effects. Adverse effects include irritability or depression.

6-7. VACCINATION SITE REACTION

Read the vaccination site this way. A skin induration of 10 mm or more is considered a reaction. Less than 10 mm induration is a nonreaction. Read the vaccination site using a millimeter ruler and only the amount of induration, not the skin redness. Reactions are classified in these three types: a positive reaction; a negative reaction; and a conversion reaction.

6-8. POSITIVE REACTION

The induration is 10 mm or more in diameter and indicates that the person has a tuberculin infection now or has had an infection in the past. Two to eights weeks after a person is infected with the tubercule bacillus, the skin test may provide a positive reaction. Disadvantaged people in all countries have a higher rate of positive reactions.

6-9. NEGATIVE REACTION

Induration less than 5 mm in diameter is considered a negative reaction and indicates that a tuberculosis infection is unlikely. A variety of factors make it possible for the tuberculin reaction to decrease in size or even disappear even though the person has tuberculosis. These factors include overwhelming tuberculosis, exanthematous (eruptive) diseases, corticosteroid treatment, sarcoidosis, debility, and increased age. Also consider that there may be something wrong with the materials used in testing. If you suspect that the person may have tuberculosis, even though the reaction is negative, give that test again or use another method of testing for tuberculosis.

6-10. CONVERSION REACTION

A positive reaction that has developed within a year after a negative reaction is called a conversion reaction. This means that the skin induration has changed from a skin induration of less than 10 mm in diameter a year ago to a skin induration greater than 10 mm in diameter and that the increase in the size of the induration is at least 6 mm. The importance of this finding is that it indicates that the person may have had a tuberculosis infection recently. That person will need to be checked periodically because the possibility of developing tuberculosis is greatest during the first two years after an infection.

6-11. GENERAL MEASURE OF CONTROL

It is more difficult to control outbreaks of respiratory infections (including tuberculosis) than many other types of communicable diseases. In general, control efforts are based on improving personal hygiene, avoiding contacts with patients and carriers, controlling dust and aerial contamination, preventing overcrowding and fatigue, and immunizing when applicable.

a. **Avoidance of Direct Contact**. Patients with a respiratory disease such as tuberculosis must be diagnosed, isolated if necessary, and treated as soon as possible. Additionally, these patients should learn and practice personal hygiene measures such as covering the mouth when coughing or sneezing.

b. **Person Hygiene**. Personal hygiene is one of the most important respiratory disease control measures. The approach is through the practice of simple health habits. Covering the nose and mouth when sneezing or coughing and washing the hands should be routine practices. People infected should avoid contact with healthy persons. Personal articles such as towels, drinking glasses, and toothbrushes are not shared. Healthful exercise, fresh air, and sunshine should be encouraged.

Continue with Exercises

EXERCISES, LESSON 6

INSTRUCTIONS. Answer these exercises by writing the answer in the space provided. After you have answered all the exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers.

1. Tuberculosis, a chronic disease, is caused by _____.

2. List three reasons for the decline in the number of tuberculosis cases.

   a. _____.

   b. _____.

   c. _____.

3. List four signs/symptoms of tuberculosis.

   a. _____.

   b. _____.

   c. _____.

   d. _____.

4. Two methods of diagnosis for tuberculosis are _____ and tuberculin skin testing.

5. List two methods of transmission of tuberculosis.

   a. _____.

   b. _____.

6. The _____ test and the _____ test are two types of skin tests which can be used to diagnose tuberculosis.

7. Both types of skin tests are based on the fact that _____.

8. List three adverse reactions that isoniazid, the drug of choice in tuberculosis treatment, can have.

   a. _____.

   b. _____.

   c. _____.

9. _____ is a tuberculosis treatment drug that moves readily into all the body tissue fluids, including the cerebral spinal fluid.

10. A patient being treated for tuberculosis with the drug _____ may experience adverse reactions such as vertigo and generalized dermatitis.

11. Name an adverse reaction which might be experienced by a patient taking the drug ethambutol for tuberculosis _____.

12. A tuberculosis patient can infect others as long as the patient discharges _____ .

13. List three reasons when a tuberculosis patient would need bed rest.

   a. _____.

   b. _____.

   c. _____..

14. The length of time between exposure to tuberculosis and the appearance of a primary lesion of first infection is usually about _____.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES, LESSON 6

1. The bacteria Mycobacterium tuberculosis. (para 6-1)

2. You are correct if you listed any three of the following:
   Education. Diet.
   Preventive measures. Early diagnosis. (para 6-1)

3. You are correct if you listed any four of the following:
   Fatigue. Night sweats. Irregular menses.
   Anorexia. Cough. Pleuritic chest pain.
   Weight loss. Blood-stained sputum. Low grade fever. (paras 6-3a-i)

4. Chest x-ray. (para 6-4a)

5. Inhaling an airborne droplet which has the tuberculosis bacteria.
   Drinking raw milk from cattle infected with the bovine strain of tuberculosis.
   (para 6-2)

6. Tine; Mantoux. (paras 6-4b(1), (2))

7. The skin is hypersensitive to a specific bacterial protein antigen. (para 6-4b)

8. You are correct if you listed any three of the following:
   Peripheral neuropathy.
   Central nervous system irritability.
   Urine retention.
   Depletion of vitamin B6. (para 6-6a(2))

9. Rifampin (Rifadin^{R}). (para 6-6b)

10. Streptomycin. (para 6-6c(2)

11. Optic neuritis. (para 6-6d(2)(b)

12. Tubercle bacille. (para 6-2c)

13. Patient has a fever.
    Patient has blood-stained sputum.
    Patient has severe cough. (para 6-5)

14. Four to six weeks. (para 6-2b)

End of Lesson 6